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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

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SATURDAY, JULY 7, 1928.

CONTENTS.

The Impact of the State on Scientific Research.

IN consequence of a recommendation of the Select Committee of the House of Commons on Estimates, the Prime Minister, in October 1926, constituted a Sub-Committee of the Committee of Civil Research "to consider the co-ordination of research work carried on by or under Government, to report whether any further measures be taken to prevent overlapping, to increase economy and efficiency, and to promote the application of the results obtained." Mr. Ormsby-Gore was appointed chairman of the Sub-Committee, Major Walter Elliot was the other parliamentarian, the other members being permanent officials of the various departments concerned in the inquiry. The inquiry was spread over a year, the Sub-Committee reported on Dec. 14, 1927, and the results of its deliberations were made public on June 14 last.[1]

With such terms of reference, it might reasonably have been expected that the Sub-Committee would consider it its duty to present a critical survey of the present organisation of the State-maintained or -assisted research services of Great Britain, to present broad details of the expenditure involved, to express its own views on the relative merits of the varying types of organisation which came under its purview, and to have given some indication of the directions in which the results of research might be applied with advantage to the community, and the new researches that were necessary. In these respects the report of the Sub-Committee is disappointing. It is critical of the attitude of indifference to research of former generations, but

[1] Committee of Civil Research. Report of the Research Co-ordination Sub-Committee. (London: H.M. Stationery Office, 1928.) 2s. 6d. net.

it is difficult to detect in its complacent generalisations on the present organisation of research whether it considers any changes desirable or that it is satisfied that the existing machinery works to the best advantage.

The report is evasive and apologetic in turn. It gives the impression that expenditure on research has to be defended against possible attacks by the ignorant, rather than justified to those who understand the real purpose of research and whose aim it is, in the interests of scientific research generally, to exact the greatest degree of efficiency from the instruments by which it is conducted.

Scant attention is given to the industrial research associations. No opinion is expressed regarding their future, although the Sub-Committee could not have been ignorant of the difficulties with which most of them have had to contend since their inauguration, and the fact that the Million Fund, out of which they have hitherto derived about half their yearly income, will be exhausted in a very short time. What is to happen to them if, for a variety of reasons, the industries they are intended to serve fail to make them self-supporting within the time limit stipulated by the Department of Scientific and Industrial Research? Has the policy laid down for those associations been sufficiently well defined? Is the present organisation of industrial research on a sound basis? Is the machinery for its co-ordination adequate? Is it considered the experiment has been sufficiently successful to justify the State providing ample guarantees for its continuance? It has been left to Lord Balfour to answer this last question. He informed a deputation representing nineteen of the associations which he received on June 29, that the Government is satisfied that the research associations have proved of real utility to the industries they represent. Accordingly, in order to help them to expand the scope of their work and to stabilise the position of the scientific workers attached to the associations, it has been decided to extend the period over which financial assistance is to be given.

Many other queries also come to mind. Which system of research for the fighting services is the better, that adopted by the Board of the Admiralty and the Air Ministry, or that in force at the War Department? Does the committee consider that it is desirable that the responsibility for the arrangement of any research undertaken at the Research Department, Woolwich, should be vested even nominally in a "Chief Superintendent directly under a Director in the Department of the Master-General of the Ordnance," particular when the office of chief superintendent is held alternately by naval and military officers? This alternate succession must constitute a disturbing factor unless this and the other subordinate administrative posts in the Department held by officers of the fighting services are sinecures.

As regards meteorological research, the Sub-Committee refers to the impact of the work of the Meteorological Office on that of a number of different departments, to the recommendation made after the War to transfer it to the Committee of the Privy Council for Scientific and Industrial Research, and to its attachment to the Air Ministry in 1919. But no opinion is expressed regarding the desirability of this arrangement, which the Sub-Committee must have been aware has been the subject of a good deal of informed criticism. There is no reference to the present unsatisfactory state of the Geological Museum, although this matter was the subject of strong comment in the last report of the Advisory Council for Scientific and Industrial Research. We fail to find any reference to the need for research in the social sciences as distinct from medical research, or for anthropological and geographical research in connexion with Colonial administration. There is a further omission to express any opinion regarding the present state of veterinary research in spite of the fact that this is a matter which has for some time past engaged the earnest attention of the chairman of the Sub-Committee.

On only one subject of importance has the Sub-Committee expressed definite views. These occur in the last three paragraphs of the report and deal with the publication of scientific knowledge. The Sub-Committee rightly considers that the present variety of means adopted by different Government departments for the publication of results of scientific value is not an advantage. Each department has been a guide to itself in the matter, and sufficient account has not been taken either of the need for co-ordination and uniformity of presentation of results obtained by men of science in the Government service, or of the importance of ı ing their contributions to knowledge as contribut to the common stock, inseparable from those scientific workers outside the Government servi "It is," says the Sub-Committee, "incumbent on the Government to avoid adding to the mass publications that must be searched by scient workers if there already exist adequate means fo the purpose in the scientific world." It co that the most effective publicity for results

obtained by means of the *Proceedings* and *Transactions* of the various learned societies and technical journals, hitherto "undertaken at the charge of individual workers banded together for the purpose." It therefore envisages the possibility of more extended use being made by Government departments of these agencies and of direct State contributions towards the cost of such publications. Evidently it considers that the increase, made in 1925, of the Treasury grant to the Royal Society in aid of publications, has been thoroughly justified, and it is permissible to assume that an application for a further increase would be received favourably.

This is the only bright spot in an otherwise dull summary of the methods by which the State fosters research, either in Government laboratories staffed by professional Civil Servants or in State-maintained or -assisted research institutions. It is conceded that such a summary will serve a useful purpose; it might, for example, stimulate more parliamentarians to take an active interest in a matter of vital importance to the nation by enabling them to appreciate the influence of scientific research on our social and economic life, but it was scarcely necessary to have called together so eminent a body to compile what appears to be a digest of various departmental memoranda, the only excursion into matters of policy being that noted above.

The composition of the Sub-Committee possibly accounts to a certain extent for the nature of its report. It is surprising, however, that its members did not realise that the following passage, taken from paragraph 236 of the report, dealing with the Research Council of the Ministry of Agriculture and Fisheries, needs only the substitution of "Departments" for "Institutes" to explain their own failure to deal fully with their terms of reference:

"A body consisting mainly of the heads of Institutes engaged for the most part on research in different fields is not, however, well adapted for the consideration of research policy. Directors of Institutes not immediately concerned can hardly be expected to offer opinions on subjects outside their own sphere or to criticise the work of Institutes for which their colleagues on the Council are immediately responsible."

Possibly if this Research Council consisted *solely* of directors of institutes its effectiveness might increase, and possibly if the directors of the various research departments had been entrusted with the task of preparing a preliminary report for the guidance and consideration of the two Ministers who served on the Research Co-ordination Sub-Committee, the final report might have been a more satisfactory document.

The Way the World might go.

The Way the World is Going: Guesses and Forecasts of the Years Ahead. 26 Articles and a Lecture by H. G. Wells. Pp. xi + 301. (London: Ernest Benn, Ltd., 1928.) 7*s.* 6*d.* net.

The Open Conspiracy: Blue Prints for a World Revolution. By H. G. Wells. Pp. 156. (London: Victor Gollancz, Ltd., 1928.) 5*s.* net.

MEN of science owe a debt of gratitude to Mr. H. G. Wells. He was born with a passion to make things better, and there is implicit in all his writings the view that the advancement of science and the application of scientific knowledge is the indispensable method whereby this end may be achieved. This passion has lost none of its intensity as the years have passed. No trace of cynicism has crept in. He remains as eager, as impatient, and as youthful as ever. He has not accumulated a series of tricks which he performs for the public amusement or "pour épater les bourgeois." He argues, debates, and pleads like the young man just becoming aware of all the absurdities, complexities, and possibilities of life.

Not to have grown old, weary, formalised, or pontifical is an achievement. Exuberance and vitality, a passion for the better ordering of society, a belief in science, are with Mr. Wells as they have always been. Add to that a sixth sense of understanding how ideas and experiences react upon different types of men and women brought up in different social strata, of sensing and expressing social relationships with their economic background: remember that to religious and æsthetic experience Mr. Wells is almost wholly insensitive, and we have some explanation of his positive achievements. His main achievement lies in his novels. In them is displayed an understanding of social as distinguished from individual relationships and experiences, which cannot be paralleled. The existence of Mr. Wells's novels relating to the War will make it possible in the future to understand how men and women were affected by that crisis in human affairs better than we can grasp how any crisis in the past affected those who lived through it.

This achievement, however, is incidental to Mr. Wells's main purpose. He wrote because he had lessons to teach. Every now and then he has tried to convey his lessons in some other form. Thus he has given us utopias, histories, newspaper articles. No matter what form he selects, his vitality carries us along. Nevertheless, as he departs from the form of the novel, we become

conscious of a certain thinness and a certain dryness. The further Mr. Wells gets from men and women, though his powers may be limited to portraying types rather than personalities, some virtue seems to depart, some cunning to leave him. It appears that it is only contact with the flesh and the hot breath of struggling men and women that moves him to his best work. When he contemplates men in abstraction his temperature falls. When he visualises *A*, *B*, and *C* as types of social classes *a*, *b*, and *c*, and brings them together, his imagination is fully exerted, his humour is at work. He flashes out remarks which illuminate our social problems. But when he begins with classes *a*, *b*, and *c*, his powers are not stimulated in the same fashion, and the illumination is correspondingly reduced.

(1) It is a bold thing to collect and publish in book form articles from newspapers on topics of the day. But these articles stand the test. They have vitality and width of vision. The topics discussed are viewed in relation to a broad background, and thus stand in contrast to the common run of journalism in which the attitude of the day alone is represented. The thought common to all these discussions is expressed in the following sentence. "While we are representing life in melodramatic colours as a struggle between the 'Haves' and the 'Have-nots,' the less romantic and interesting reality of a struggle between scientific organisation on the one hand and the alliance of personal greed with chaotic stupidity on the other may be undermining all the grounds of our melodrama."

It is on account of this emphasis on a scientific ordering of our affairs that we should be grateful to Mr. Wells. Men of science are only too apt to content themselves with the application of scientific method to their particular sphere, and to watch without protest the unsystematic, short-sighted, and blundering attempts to mend our social and economic organisation. It may seldom fall to men of science to go themselves outside their spheres, but they are untrue to their guiding principles if they do not urge that those who move in the political arena should attempt to plan and organise in what is essentially the spirit of science.

Mr. Wells admirably fulfils this task of appearing as the prophet of the scientific method in the social field. He is at his best when he is in contact with a concrete problem. In this book is included a lecture given in Paris, which is, as he tells us, "much more closely written than the rest of the book." It is not so alive as the rest of the book. Mr. Wells moves awkwardly in the world of abstractions. He seems to be wanting to get out of the study again and hear what people are saying and watch the expressions on their faces. His literary style, which is not unsuited to convey the jumble and flow of life and contact of man with man, is an uncouth weapon for dealing with academic niceties.

(2) What has just been said applies to "The Open Conspiracy." Mr. Wells has attempted to set down his programme. The book states "the essential ideas of my life, the perspective of my world. . . . This is my religion. Here are my directive aims and the criteria of all I do." Readers of "William Clissold" will remember hearing of the "open conspiracy." In that vivid work is conveyed the idea of the co-operation of men and women of good will and wide outlook in the task of producing world order and harmony. The programme as suggested in "William Clissold" is just definite enough to be real. It is not formalised or presented in an orderly fashion, but it comes through the incidental discussions and descriptions, and comes, moreover, with freshness. The book vibrates. It is exciting. It is concrete. Here Mr. Wells attempts a fuller treatment, more logical and more abstract. It has not the same compelling force.

Interesting and conspicuously sincere as the book is, Mr. Wells's genius is not well suited to this kind of presentation. In the novel form he can suggest the case for the control of population or the stabilisation of prices so as to make them overwhelming. He can show how absurdly some character fears the one and another character misunderstands the other. But when he tries to state the case in essay form, the result is somewhat commonplace and even jejune. The nature of the programme must already be familiar to readers of the novels: the organisation of world peace, the world organisation of credit, transport, and staple production, population control. He looks to its fulfillment coming through informal groups of people in substantial agreement with the main points in the programme who will work for it. It would appear that Mr. Wells has been impressed by the success of Bolshevism and Fascism in capturing the imagination and in focusing the energies of young people, and hopes that his very different programme may do as much.

Surely there is all the difference in the world between the ideals and dogmas of the Fascists and the Bolshevists, which demand from the mass of their adherents mere blind adherence, and Mr. Wells's programme, which is that of following

the light of science as an aid to social betterment and of accepting only that of which the informed intelligence approves. The "open conspiracy" is not likely to achieve its peaceful revolution in that way. The best hope lies, perhaps, in the joint approach to these problems by teachers and students in our universities, of which Mr. Wells speaks somewhat slightingly, and in the hope that some day the great body of men trained in science will refuse to remain content with the restriction of their methods to narrow fields, and will insist that they be applied to the wide and difficult problems of social organisation.

A. M. C.-S.

The Cutaneous Circulation.

The Blood-vessels of the Human Skin and their Responses. By Sir Thomas Lewis. Pp. xv + 322. (London: Shaw and Sons, Ltd., 1927.) 37*s*. 6*d*. net.

SOME time ago a paper was sent to a certain society for publication; the comment made upon it was: "Whoever undertakes to act as referee will have to do a year's solid work before he sends in a report." The author of the present review feels much in the same position as the prospective referee. Sir Thomas Lewis has struck right out into new country and very important country. Moreover, it is a matter of great interest that the country is not very far away. There are few parts of the human frame which the doctor can see; with regard to most he has to go on inference. Of the few which he can see, the skin is one.

The step forward with regard to the skin is that it is now beginning to be regarded as an organ. Although, of course, it has long been a commonplace that the principal regulation of heat loss is carried out in the skin, thought has unconsciously settled too much round this word 'integument' as being synonymous with 'skin.' Whilst the importance of the skin as a covering cannot be over-estimated, its importance as an organ of the body which undergoes physiological changes in unison with other organs can be, and has been, very much under-estimated.

The significance which the skin has acquired in the eyes of those concerned with the *modus operandi* of the human body has arisen from several circumstances; of these, one is the recent expansion of knowledge with regard to the capillary circulation; another is the action of radiation, ultra-violet and otherwise; and a third, though in a more restricted way, the action of certain poisonous substances used in the War.

Some such considerations as the above will make many readers welcome, and welcome in no small measure, "The Blood-vessels of the Human Skin and their Responses." Moreover, Sir Thomas Lewis tells us in the preface, his original object in commencing the book was, to state in a consecutive and orderly way the observations which he had made on the cutaneous vessels. But this was not his only reason for writing the book. Regarding education from the point of view of a teacher of medicine, he was prompted by "a desire to stimulate a wider study and teaching of human physiology; for knowledge of healthy man forms the most manifest and abiding bond between physiology and medicine."

Chapter i. is introductory; it has to do largely with the anatomy of the vessels in the skin, but in the second, third, and fourth chapters an account is given of basal reactions on which the conceptions in the subsequent chapters are founded. These reactions are four in number:

Reaction.	Cause.	Mechanism.
White reaction.	Gentle stroking.	Contraction of small vessels.
Red reaction.	Vigorous stroke with blunt point.	Relaxation of small cutaneous vessels due to the local production of a chemical dilator.
Flare of red area surrounding the stroke.	Abusive or repeated strokes with blunt point.	Axon nervous reflex from the abused area causing *arterial* dilation in the vicinity.
Wheal.	Still more drastic stimulation except in the case of sensitive skins, where the stimulation which ordinarily produces a red reaction and flare may produce a wheal.	Due to increased permeability of the walls of the small cutaneous vessels.

Of the four reactions named above, the white reaction appears to be a physiological response, possibly to stretching of the skin. The significance of the whole reaction is somewhat uncertain; indeed it may be permissible to raise the philosophic point with the author. Does it follow that an observed phenomenon necessarily has a significance? If he could definitely answer that question in the affirmative, biological science would be easier for those who pursue it.

To return from this digression, there remain the other three phenomena, the red reaction, the flare, and the wheal. These are the result of a lesion, be it ever so slight. The burden of the succeeding

chapters is to show that they are the result of the same lesion; whether only the red reaction occurs, or the red reaction plus the flare, or the whole three depends upon the extent of the lesion. The complete response, however, embraces the whole three, and for that reason the author includes the whole three in the term the *triple response*. The triple response thus consists of: (1) a strictly localised chemical stimulation; (2) an axon reflex; (3) an increased permeability of the vessels.

Some great man has defined the mission of science as being the reduction of numerous phenomena to a few simple underlying principles. If that be a true definition, Sir Thomas Lewis has furnished an excellent example of the scientific method: for the three individual components of the triple response are all, according to him, traceable to a single cause, namely, the liberation of some product of tissue disintegration at the seat of the lesion. This product, which he regards either as histamine or as something closely akin to it, and which he terms a histamine-like substance, apparently does three things: (1) it dilates the vessels at the immediate site of its production; (2) it stimulates nerve endings there, which, as the result of axon reflexes, dilate the arterioles over the area immediately surrounding (the flare); and (3) increases the permeability of the vessels so that exudation takes place through their walls (the weal).

In a certain number of persons, Chapter ix. will awaken considerable interest. In it Sir Thomas Lewis reduces burns of long-latent period, *i.e.* burns caused by radiations, $\beta\beta$ dichlordiethyl sulphide ('mustard gas'), etc., to the same general type as the more immediate injuries to the skin produced by freezing, stroking, etc. The sympathetic reader will want to know much more from Sir Thomas than he tells. That perhaps is the label of all great work.

Two questions arise at once.

(1) It is the general opinion of persons who deal with such burns, that, given a burn of a certain initial gravity, the time taken for healing differs greatly according to the cause of the burn. A burn caused by hot water will heal rapidly, an X-ray burn slowly, and a mustard burn neither so rapidly as a scald nor so slowly as an X-ray burn. Is this belief well or ill founded? And if well founded, what is the explanation? (2) It is the belief of those who see much of mustard burns—I think it is the universal belief of such—that one mustard burn sensitises the subject and that a series renders him almost incredibly sensitive to the gas. Is this belief well founded? And if so, what is the explanation? I am speaking now of definite burns in which the epidermis comes away at an early stage. If the epidermis, while still *in statu quo*, merely expelled a certain amount of histamine into the underlying tissues, why the difference in the time taken for healing as compared with the gravity of the initial lesion? When the body is rendered sensitive to mustard, is it really rendered sensitive to mustard or merely to histamine? If the latter, does a scald render the body (not at the site of the scald) sensitive to subsequent scalds?

The consideration of these more extensive lesions forms a natural transition to the later half of the book. This deals largely with the general regulation of the blood flow over extensive areas. Such topics are treated as the colour of the skin, the relation of blood supply to the metabolic processes not only of the skin but also elsewhere, the degree of tone maintained in the various vessels of the skin, and so forth. These subjects are discussed along the general lines indicated in the earlier chapters. A certain amount of this portion of the book is not outside the region of controversy, which fact does not detract from the necessity of reading this work. Indeed, anyone who reads it will close it with the fixed idea that to leave it unread is to be uninformed on the colour and appearance which the skin presents both in health and in disease.

The book is produced with the meticulous care to which all Sir Thomas Lewis's readers are accustomed. This applies not only to the form of expression and the type, but also eminently to the illustrations.

J. B.

An Encyclopædia of Agriculture.

Handbuch der Landwirtschaft. Herausgegeben von Fr. Aereboe, J. Hansen und Th. Roemer. In fünf Bänden. Band 2, Lieferung 1. Pp. 128. 5·80 gold marks. Band 3, Lieferung 2. Pp. 128. 5·80 gold marks. (Berlin: Paul Parey, 1928.)

FOR some reason not altogether easy to understand, German publishers have not taken kindly to the idea of publishing encyclopædias of agriculture. It is forty years since the well-known "Handbuch der Landwirtschaft" of Freiherr von der Goltz was issued, and during the intervening time there have not only been great changes in agriculture itself, but also large encyclopædias have been published in England, America, and Denmark,

and an encyclopædic series of volumes has been issued in France. Now Messrs. Paul Parey are issuing a new 'Handbuch,' of which the first two sections have reached us.

The book is written for the agriculturist, especially for the student and lecturer in agriculture. It gives a concise account of the various branches of the subject brought well up-to-date and embodying modern ideas and results.

It differs in plan from the ordinary encyclopædia, being a collection of short treatises and not articles arranged alphabetically. The five volumes are to deal respectively with: (1) General agriculture, including its history and economics, organisation, finance and marketing; (2) soil and soil management; (3) crops; (4) general animal husbandry; (5) special animal husbandry.

The soil section is written by Dr. F. Schucht, the well-known authority in Berlin, who has managed to condense into forty pages an excellent summary of the present position of our knowledge of the origin, the chemical and physical properties of soils. Thanks to the work of the Russian investigators, soil classification is now on a broad basis, but this necessitates that the student and, above all, the teacher, should know something about the properties of other types of soil, such as the steppe, black earth, alkali soils, in order that he may appreciate properly the properties of the brown soils which predominate in Germany and other parts of Europe. The necessary information is clearly set out without unnecessary detail. At the end of the section there is a small list of German books in which the subject is pursued further, but in neither of the two books before us are references given to original papers. Perhaps, in view of the general nature of the 'Handbuch,' this was deemed unnecessary.

Dr. F. Löhnis, of Leipzig, deals with the microbiology of the soil, discussing the part played by micro-organisms in bringing about changes of importance to the plant, and the influence of natural and artificial conditions. This section is somewhat in the style of his lectures published some years ago, and it shows that he has the capacity for reducing the enormous mass of material collected in his "Handbuch der landwirtschaftlichen Bakteriologie" to a simplicity of statement that can be followed by the ordinary student.

Dr. Münzinger, of Hohenheim, follows with an account of meteorology in its relation to agriculture, discussing the influence of various climatic factors on the yield and quality of agricultural crops, and devoting a section to hail, a very serious trouble in some parts of Germany. The damage seems to be considerably greater in Baden than in Prussia, and generally worse in South Germany than in the north. There is also a useful summary of climatic conditions in the various regions of Germany.

The volume dealing with crops is on the same general lines. Each section is by a well-known authority on the subject, and written in a general way, giving the broad outlines with not too much detail, and in particular no detailed references to papers, but always a list of German books where full information can be obtained. Dr. F. Berkner deals with the cereals, rye, wheat, barley, oats and maize, giving an account of the varieties, phenomena of growth, and the cultural requirements of each crop. It is interesting to note that some winter barley is grown in Germany although its cultivation is difficult in Great Britain. In the description of the manuring of barley, great stress is laid on the need for supplying all three nutrients, nitrogen, phosphate, and potash, except where the crop is taken after one that has been itself heavily manured. Dr. Opitz' account of potato culture, of which the first part is published, promises to be one of the most interesting accounts of German practice.

It is difficult to judge entirely from two sections what the book is going to be like, and we hope that in succeeding parts the problems of plant disease will be adequately dealt with, these being among the most difficult in crop production. In the soil volume also, when it is complete, we shall hope to find an adequate treatment of cultivation implements, and especially of power for working them.

This idea of bringing together a group of experts, each to present his general experience without too much detail, has attractive features, and the result is, so far as we can tell from the sections published, a summary that will help the agricultural lecturer to keep up-to-date. It has long been a reproach that the lectures on agriculture have usually lagged behind the times and have not been modified by progress made either in research institutes or by the body of workers who are studying cost accounts. In extenuation it must be recognised that the lecturer would have an almost impossible task if he tried to keep pace with the great output of agricultural literature. Summaries are therefore essential, and these two sections indicate that the German lecturer, at any rate, will be well catered for by the new 'Handbuch.'

Modern Applications of the Kinetic Theory.

Kinetic Theory of Gases: being a Text and Reference Book whose Purpose is to Combine the Classical Deductions with Recent Experimental Advances in a Convenient Form for Student and Investigator. By Prof. Leonard B. Loeb. Pp. xvi+555. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 27*s.* 6*d.* net.

PROF. LOEB'S book is very similar in appearance to the well-known Monograph Series of the American Chemical Society; but, although the kinetic theory of gases has always occupied a very important place in physical chemistry, the book is from first to last a 'text and reference book' of pure physics.

The author claims with justice that the kinetic theory of gases "is to-day perhaps the only field in which the mechanical picture has not been dimmed by the breakdown of our mechanical concepts"; but it is a surprise to find how the scope of the theory has widened since the outlines of the picture were drawn by Joule, Clausius, Maxwell, and Boltzmann. New developments began in 1908, when the brilliant experiments of Perrin brought to an abrupt end the Ostwald system of energetics, which professed to reduce the atom and molecule to the position of superfluous hypotheses. The proof given by Perrin of the real existence of molecules, and of their incessant jostling with one another, has been accompanied by a second line of development, in which ions and electrons play the part of molecules and atoms. These charged particles provide new opportunities for studying the kinetic phenomena of gases by electrical methods, as in Millikan's determination of the Avogadro number from the movement of electrified oil-drops in an electrical and gravitational field. In the same way, Blackett's study of forked α-particle trails is cited, with Aston's experiments on the mass-spectrograph, as confirmatory evidence of the atomic and molecular weights deduced in the first instance by means of Avogadro's hypothesis. An account is also given of measurements of the mean free path of *electrons*, projected with a wide range of velocities through gases at very varied pressures, and of the application of these electrical methods (as alternatives to observations of gaseous viscosities) for determining molecular areas.

Another unexpected but very welcome feature of the book is an account (covering about twenty pages) of Debye's work on molecular moments. The inclusion of Debye's "beautiful explanation of the paradoxical situation, . . . where the second equation held whilst the one from which it was derived failed," is justified by the author by reason of its relation to the kinetic theory, and of the desirability of making it familiar to American students, to whom it might otherwise be inaccessible on account of language difficulties and its omission from the usual reference books; but English readers will be equally glad to read so clear an account of a rather complex problem in optics.

The eleven chapters of the book are followed by half-a-dozen appendices. Most of these are tables giving the numerical values of various constants and functions, but there is also a very valuable summary of the methods that have been used to determine the diameters of molecules, together with the data obtained for nineteen of the simpler gases.

T. M. L.

Our Bookshelf.

Annual Survey of American Chemistry. Vol. 2: July 1, 1926, to July 1, 1927. Edited by Clarence J. West. (Published for National Research Council.) Pp. 415. (New York: The Chemical Catalog Co., Inc., 1927.) 3 dollars.

THE series of annual volumes constituting this survey was inaugurated in order that chemists in the United States of America might be given a perspective view of the advance made in their various fields of research (subject, of course, to the very limited horizon defined in the title), and in order that the importance of certain prospective researches might be adequately emphasised. The first volume, covering the fiscal year July 1925–July 1926 of the National Research Council, evidently proved acceptable, since the second volume, that for 1926–27, has undergone (together with its price) an expansion of 50 per cent.

In addition to recording achievement, many of the fifty-one contributors offer suggestions for research in various directions. The omission of an author index from vol. i. is now repaired by the provision of separate author indexes for both volumes; in addition, a brief résumé is given of the researches actually undertaken under the plan outlined in the former issue for promoting co-operative researches between industries and universities. It is, however, somewhat surprising to learn that "the laboratory facilities for chemical studies in colleges and universities, outside of the leading institutions, are abominable and a disgrace to learning. Among the leading institutions . . . the great majority are not keeping abreast of the times." The present volume contains 44 chapters, and deals with an extensive range of subjects in pure and applied chemistry.

A. A. E.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Frank C. Whitmore, Editor-in-Chief. Vol. 7. Pp. vii + 105. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 7*s.* 6*d.* net.

THIS series has attained a recognised position as a useful adjunct to research workers and others who are engaged in the practice of organic chemistry. The latest issue contains precise directions, which have been independently checked in each instance, for carrying out thirty organic preparations. Although the contributors to this volume are mainly American, the international character of the undertaking is indicated by the fact that the list of authors includes the names of Holleman (Amsterdam), Lapworth (Manchester), Reverdin (Geneva), and Ziegler (Marburg). Among interesting substances the preparation of which is described are chloroacetamide, *p*-chloromercuribenzoic acid, diphenic acid, furan, furfuralacetone, guanidine nitrate, nitroguanidine, *α*-methyl mannoside, pentene-2, triphenyl stibine, xanthone, and anhydrous hydrogen cyanide. In the last-named preparation mention is made of Gattermann's interesting recommendation "that the operator smoke during the preparation, for he found that a trace of hydrogen cyanide is sufficient to give the tobacco smoke a highly characteristic flavour. This preliminary warning is useful in case of leaky apparatus or a faulty hood." Most of the methods given are based on known reactions, but considerable alterations in the published conditions have often been found necessary in order to secure satisfactory yields. In the case of anhydro-2-hydroxymercuri-3-nitrobenzoic acid, here described by Whitmore, Culhane, and Neher, no method of preparation has hitherto appeared in the literature.

Venereal Disease: its Prevention, Symptoms, and Treatment. By Hugh Wansey Bayly. Third edition. Pp. xv + 242 + 3 plates. (London: Faber and Gwyer, Ltd., 1927.) 10*s.* 6*d.* net.

THE third edition of this book does not differ in general arrangement from the second. Dr. Wansey Bayly continues to emphasise the need for more drastic steps in the campaign to prevent venereal disease, particularly urging the encouragement of self-disinfection and a scheme for notification and segregation under State control. While the latter suggestion may not meet with unanimous approval, it will be generally regretted that the recommendations of the Trevethin Committee should be completely ignored. The chapters on treatment have been extended to include references to scabies, pediculosis, diathermy, and the modern methods of dealing with dementia paralytica. The quoted results of induced malaria treatment recorded at one hospital are not encouraging, but they are not representative of general experience; Dr. Bayly cautiously refrains from dogmatic statements, but indicates two extreme views on the subject. The number of illustrations in the book has been considerably increased.

(1) *The Weather: an Introduction to Climatology.* By Dr. C. E. P. Brooks. (Benn's Sixpenny Library, No. 145.) Pp. 79. (London: Ernest Benn, Ltd., 1927.) 6*d.*

(2) *Börnsteins Leitfaden der Wetterkunde.* In vierter Auflage neu bearbeitet von Walter Brückmann. Pp. vi + 284 + 22 Tafeln. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1927.) 15 gold marks.

(1) DR. BROOKS's little book is worthy of a wide public, and is an admirable example of popular exposition of science. Readers in whom it arouses a wider interest in meteorology and climatology are guided to further sources of knowledge in English books.

(2) Those who can read German can benefit also by Börnstein's well-known treatise, which has been largely revised by W. Brückmann in the fourth edition. It covers a wide field in great detail (considering the size of the book); the forms of clouds are indicated in a set of sixteen beautiful photographic plates which form a very attractive feature of the book.

Die heimische Pflanzenwelt in ihren Beziehungen zu Landschaft, Klima und Boden. Von Prof. Dr. Felix Rawitscher. Pp. ix + 238 + 12 Tafeln. (Freiburg im Breisgau: Herder und Co. G.m.b.H., 1927.) 6·80 gold marks.

THIS small book deals in a most interesting manner with the plant life of central Europe, and gives an extremely good idea of the modern tendencies of geographical botany. The environmental factors are concisely analysed, and their effects on the vegetation and flora are adequately illustrated by specific examples. The vegetation is described under the three main headings: forest, forest-free areas, and waters (fresh and sea). The geological history of the flora is summarised with special reference to the Glacial and post-Glacial periods. Eleven plates, of 21 excellently selected photographs, accompany the text, which is further illustrated by 64 black-and-white figures. These last include many outline distributional maps of very clear design. References to literature are given at the ends of the chapters and as foot-notes, and an index is provided. The work has a wider scope and a more general interest than is indicated by its title. W. B. T.

The Light of Experience: a Review of some Men and Events in my Time. By Sir Francis Younghusband. Pp. x + 305. (London: Constable and Co., Ltd., 1927.) 15*s.* net.

SIR FRANCIS YOUNGHUSBAND's latest book begins with a short sketch of his life, and ends with a philosophical judgment on his experiences. The book, in fact, is partly an autobiography and partly a philosophical treatise. A man's philosophy is generally founded on his personal experiences, but it is not often that the two are set down together. If the practice were more common, we might obtain some interesting glimpses of the origins of various philosophies.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Absorption Spectrum of Vitamin A.

THE study of the oil-soluble vitamins has supplied overwhelming proof that both provitamin D and the antirachitic vitamin itself exhibit photochemical properties. As regards the action of light on vitamin A, the balance of opinion has, we believe, hitherto been in favour of an indirect oxidation process rather than a purely photochemical mechanism. Although the evidence for the former has been somewhat ill-founded, its adoption has led to the neglect of the latter view, which we are now able definitely to prove is the correct one.

As photochemical changes imply absorption, and presumably selective absorption, of light, we adopted some time ago the following working hypotheses :

(*a*) that provitamin D should exhibit selective absorption in the ultra-violet, and

(*b*) that vitamin A should exhibit selective absorption in the visible or near ultra-violet, since it has been demonstrated by many workers (for example, Peacock, *Lancet*, ii., 328 ; 1926) that this vitamin is destroyed either by sunlight or the light from an incandescent lamp.

The first hypothesis was confirmed by a spectrographic study of cholesterol from cod-liver oil, when three absorption bands at 293·5 $\mu\mu$, 281·5 $\mu\mu$, and 270 $\mu\mu$ were observed and shown to be criteria of provitamin D. This discovery paved the way to the recognition of ergosterol as the photochemical precursor of vitamin D.

As regards the second hypothesis, work on this has in the past been hindered by the difficulty of obtaining really rich sources of vitamin A. Since cod-liver oil is the best known source of this vitamin, it is clear that we should start from this material. The absorption spectrum of cod-liver oil had previously been examined by Schlutz and Morse (*Amer. J. Dis. Child.*, **30**, 199 ; 1925) and Schlutz and Ziegler (*J. Biol. Chem.*, **69**, 415 ; 1926), who found two absorption bands at about 328 $\mu\mu$ and 279 $\mu\mu$ in thin films of the oil. Heilbron, Kamm, and Morton (*Biochem. J.*, **21**, 78, 1279 ; 1927) also observed marked inflections in the regions 320 $\mu\mu$ and 270-290 $\mu\mu$, whilst Woodrow (*Phil. Mag.*, 943 ; 1928) has recently recorded both the band in the neighbourhood of 320 $\mu\mu$ and the fine structure associated with ergosterol. From these observations it is clearly reasonable to test the hypothesis that the 328 $\mu\mu$ band is connected with vitamin A, since no other constituent of cod-liver oil is known to show a band in this region of the spectrum.

A large and varied assortment of fish liver oils and vitamin A concentrates has now been collected and a detailed spectrographic examination made of the samples. The outstanding result of this work has been the recording of a prominent absorption band at 328·5 $\mu\mu$, the intensity of which, moreover, runs closely parallel with the vitamin A potencies of the various oils as measured by the well-known antimony trichloride colour test. Irradiation results in the disappearance of the chromogenic substance. Biological experiments have proved that aeration or oxidation also causes the destruction of the vitamin, and we have now found that the spectrographic tests indicate the same result.

In order to define the active wave-lengths more closely, a rich vitamin A containing oil was irradiated for forty-eight hours in a small silvered quartz test-tube. The advantage of the silvering lies in the fact that the thin film of metal transmits only a narrow band of the spectrum, the absorption of the oil being almost exactly the same as the transmission of the filter. Not only was the vitamin potency as determined by the colour test reduced to very small dimensions, but the selective absorption almost wholly disappeared.

It seems likely, from evidence which will be communicated in full elsewhere, that the first decomposition products of vitamin A include a substance possessing an absorption band in the region 275-285 $\mu\mu$.

Examination of 'non-saponifiable' extracts prepared in Prof. Drummond's laboratories indicates, as shown in the following table, that not only is the 328 $\mu\mu$ band present, but also that the dilution used is in good agreement with the high concentration of the vitamin present.

Material.	Prof. Drummond's Estimates ($SbCl_3$ Test).	Values from the 328 $\mu\mu$ Band.
Cod liver 1 . . .	1	1
Cod liver 2 . . .	2	1·6
Cod liver 3 . . .	3	3·2
Cod-liver oil extract *	500	200-300
Sheep-liver fat extract *	775	800-1000

* Non-saponifiable material from which all sterols have been removed by crystallisation and precipitation with digitonin.

The adoption of the 328 $\mu\mu$ band as a criterion of vitamin A will, we hope, assist in the elucidation of the chemical nature of the substance. Whilst the test may not always be as delicate as the antimony trichloride reaction, it is less empirical and in all probability more trustworthy.

R. A. MORTON.
I. M. HEILBRON.
The University, Liverpool.

Earthquake Warnings.

IN continuation of my letters to NATURE on earthquake warnings in 1923 (vol. 112, p. 538) and 1927 (vol. 120, p. 619), I should like to direct attention to an important paper by Prof. Ishimoto (*Bull. Earthquake Research Inst.*, vol. 4, pp. 203-222). Most of it is in the Japanese language and character, but there is a brief abstract in French on pp. 203-206, and the figures, plates, and tables are easily understood. These show the tilting of the ground preceding earthquakes in the Tango (Tahano) peninsula on the north coast of Japan, indicated by the 'tiltometer' (or 'klinograph') set up at Miyadu (Miyasu), 35° 27′ N. and 135° 13′ E.). The observations were carried out immediately after the great Tango earthquake of Mar. 7, 1927, and graphs are given showing the tilting during two periods from Mar. 15 to April 1, and from April 22 to Sept. 10 in the same year.

During this time there were nine earthquakes which were recorded either at Miyadu, or at Toyooka, 32 km. to the west, and had an intensity not below that indicated by II. on the Japanese scale (IV. on the Mercalli scale). All except two were immediately preceded by a marked tilting of the instrument, superposed on the minor diurnal tilts, due mainly to variations of temperature. The amount of the tilts preceding earthquakes varied from 6·5 to 19·8, and 26·2 seconds of arc, but the last took place in three stages

interrupted by contrary movements. The two exceptions were only three hours apart; one was not observed at Miyadu and the other had there an intensity of only I. on the Japanese scale, but even these were preceded by a feeble tilt. On the other hand, two earthquakes which had an intensity of only I. on the same scale were anticipated by tilts of 8·4 and 6·5 seconds of arc respectively. The diurnal tilts were usually about 2·5 seconds of arc.

The interval between the commencement of the tilt and the earthquake varied from six to thirteen days, except in one of the earthquakes with intensity I., in which it was only four days. At Kawabe, 10 kilometres to the north-west, the tilting was much feebler.

It is gratifying to find that the seemingly rash suggestion I made nearly five years ago has been so remarkably fulfilled. It is true that the results obtained by Ishimoto relate only to minor earthquakes; but the considerable change of level on the coast at Mitu and Sunakata, 5 km. and 8 km. east of the Gomura fault, two and a half hours before the Tango earthquake, indicate that on that occasion there must have been much greater tilting, and it no doubt had begun long before it was observed.

There is evidently much work to be done in ascertaining the relations between the secular movements that are always in progress, the intensity and direction of the anticipatory tilts, and the intensity and character of the earthquakes, as well as the changes of the topography that accompany them; but it has been abundantly shown that we have now at our disposal a means of saving the inhabitants of countries subject to earthquakes from the probability of bodily injury and loss of life, and even of giving them time to diminish to some extent material damages as well.

JOHN W. EVANS.

Athenæum Club, S.W.1,
June 21.

Reproductive Rhythm in Birds.

IN the issues of NATURE for April 4, 1925, and Mar. 5, 1927, were given brief accounts of the effects of subjecting juncos (*Junco hyemalis*) during the autumn to artificially increasing days in place of the normally decreasing days of that time of year. It was shown that in spite of extremely low temperatures, recrudescence of the gonads could thus be induced in mid-winter. Ordinary electric light bulbs were used as the source of illumination. This indicated that the changes could probably not be attributed to radiation. During the past winter, through a renewed grant from the Royal Society, it was possible to repeat these experiments and to introduce variations. A full account of these is shortly going to press. Considered together, they suggested that the development of the gonads was due directly to increasing activity made possible through daily extension of the waking hours.

To test this a cage was designed in which the birds could be compelled to keep moving, with only sufficient light to enable them to find the perches and prevent accidents. The cage consisted of a box 3 ft. by 2 ft. by 1 ft., with a wire front, a single perch running from end to end (Fig. 1, *A*), and food and water tins (*B*) on a level with the perch. At each end of the cage immediately above the perch and on the floor was a slit in the walls too small to permit the escape of the inmates. Outside the cage, at each end, and the width of the cage apart, were two large pulley wheels. Over them ran endless belts, passing through the cage, one at the front, the other at the back, and connected together at one point by a transverse wooden bar (*C*). The pair of wheels at one end was driven by an electric motor, the gearing being such that the bar took 40 seconds to complete a circuit, sweeping the perch and food troughs on the outward trip and the floor on the return. After the birds were deemed to

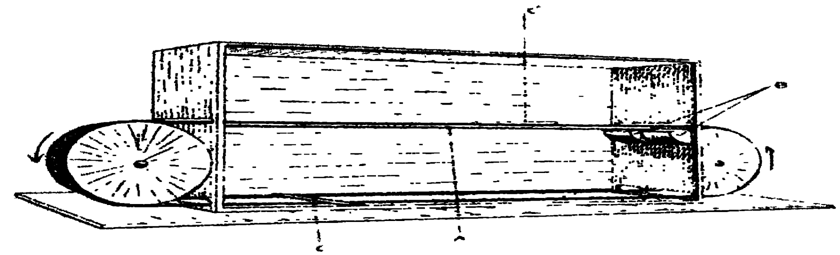

FIG. 1.—Experimental cage.

have got accustomed to the device, a second transverse bar was attached at the opposite point on the belt (*C'*). Wherever the birds might happen to be, they thus had to get out of the way of the advancing bar every 20 seconds. Nor could they go to roost on it, since it went out through the slit at the end at every turn. As they soon developed a system of merely hopping over it, the exercise could scarcely be described as strenuous.

Controls were kept in the same room and in a cage of similar dimensions, the two-candle-power bulb suspended from the ceiling bearing the same relation to each. No direct light entered either cage. As the movement of the machinery and the birds in the experimental cage tended to keep the controls awake, the latter's cage was covered with a thin sheet of translucent silk while the motor was running. The only window in the room was shuttered nightly at six and the motor started, continuing for $7\frac{1}{2}$ minutes the first night, 15 the next, and so on until going for four hours. Beyond this the time was not increased. The shutter was removed again at 9 A.M. the next day. Controls and experimentals thus had daylight for nine hours, the equivalent of a mid-November day. But while the controls could go to sleep at dark, or at least sit motionless, the experimentals were forced nightly to increasing periods of activity.

The experiment commenced on Mar. 17 and terminated on April 28. Only nine birds were available. They came in from the aviaries, and their gonads were already in the first stages of spring development, measuring about 1 mm. in length as against 0·5 mm.

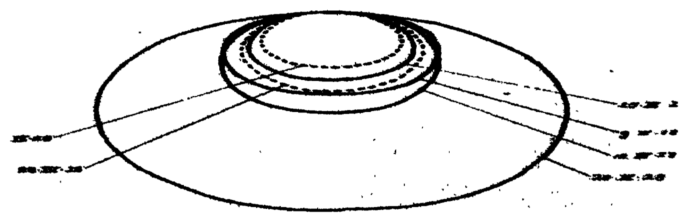

FIG. 2.—Sizes of the testes of juncos: scale, 1 mm.=0·5 inch. Dates on the left refer to controls; those on the right to experimental birds.

of the minimal winter condition. In Fig. 2 the results of the experiment are shown diagrammatically, each ellipse representing the average measurements of the two testes of single birds killed on the days indicated.

controls by broken lines, experimentals by solid. The testes of the control killed on the last day (April 28) were somewhat flattened in extraction and the size shown is consequently too large. Three birds, all males, were used as controls.[1] The third—not shown on the figure—killed on April 11, had testes the same size as the bird killed on April 3.

It would thus appear that radiation may be definitely eliminated and that increasing exercise suggests itself as being responsible for the recrudescence of the organs in the junco. The extra consumption of food, for reasons discussed elsewhere, is of questionable significance. An attempt was made, as a matter of fact, in the present experiment, to ration half the experimentals and give the others food *ad lib.*, but the partitioning of the cage led to catastrophe and was abandoned after three weeks.

The failure of the testes of the controls to develop is perhaps as interesting a feature as the history of the experimentals. The rhythm of the gonads, no doubt countless centuries old, is evidently not inherited in the junco, and yet it has apparently become inherent in other species such as the trans-equatorial migrants.

WM. ROWAN.

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Statistical Methods in Quantum Theory.

IN the application of statistical methods in the quantum theory of the ideal gas (Fermi), electron gas (Sommerfeld), and light quantum gas (Bose), a duality of treatment has been introduced. The essential difference between the two methods of determining the number of micro-canonical states of the system is that in one case (Fermi-Dirac statistics) the Pauli 'verbot' is fundamental, while in the other (Bose-Einstein statistics) this restriction is assumed invalid. There can be no doubt that the application of the Fermi-Dirac statistics has resulted in a great advance in the solution of all atomic statistical problems, while the only experimental result which appears to support the Bose-Einstein statistics is Planck's radiation formula.

It is a matter of direct logical deduction that the existence of individual particles in a system implies Pauli's principle that no two particles can have the same 'co-ordinate' or quantum number description. It is impossible, then, to understand why Pauli's principle should be applicable to molecules, atoms, protons, and electrons, but not to light quanta, and in fact it is not necessary to assume that the principle does not apply to light quanta. It is necessary to reconsider the arguments which are usually employed in these matters.

In the first place, if a set of particles is prescribed to have frequency range between ν and $\nu + d\nu$, a certain time τ is necessary for their existence and observation, and τ is equal to $1/d\nu$ (similarly for an energy range E to $E + dE$, within a very large enclosure, the value of τ is h/dE). The necessity of this finite time has always been ignored in the specification of the system, which it has been assumed in the past can be taken as instantaneous.

Let A_s be the number of discrete cells in which the N_s particles of energy between E_s and $E_s + dE$ are distributed. A_s is calculated in the usual way by the formula

$$\frac{1}{h^3}\int dx\, dy\, dz\, dp_x\, dp_y\, dp_z$$

over all possible values of the co-ordinates subject to the above-mentioned restriction on the energy. Following the argument used by Fermi, the most probable distribution which satisfies the Pauli 'verbot' is given by

$$N_s = \frac{A_s}{e^{\alpha + \beta E} + 1}.$$

In an experiment to examine the distribution of energy among the particles, a stream of particles in a narrow beam must be allowed to pass out of the box containing the gas for a time T, say, and we must take into account, in the outward flow of the particles, the fact that the time T is divided into $\mu \doteq \frac{T}{\tau}$ cells. Now μ, the number of time cells, is large, so that, considering the A_s places of energy E_s, we can have any number of quanta 0, 1, 2, 3 . . . etc., in one cell if regard is not paid to the time, and thus the Bose-Einstein statistics follows. But nevertheless, there will not be more than one quantum in the same cell if regard is paid to the time, and this corresponds to the physical facts. It is clear that we have now

$$N_s = \frac{A_s}{e^{\alpha + \beta E} - 1}$$

for the distribution actually observed.

In the absence of fields of force, α is proportional to the rest mass of the particles, so for light quantum gas this reduces to Planck's radiation law.

In general, for any particles (all of the same kind) in statistical equilibrium, the Fermi-Dirac result will be observed if the particles are counted as individuals, but for any method in which the energy is determined by integration over a finite time, the Fermi-Dirac formula will not apply unless the time is equal to τ. Instead, a distribution law of the same form as Planck's law will be observed. It must be remembered, of course, that the difference between the Fermi, Maxwell, and Bose-Einstein distribution laws will only be detectable experimentally in the case of particles of small energy.

We cannot give, in the scope of a letter, full details of the consequences of the consideration of the time in statistics. We shall only mention that the 'continuity of path' theorem has to be reconsidered. We shall present an account elsewhere in the near future.

R. J. CLARK.
W. H. WATSON.

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The University, Edinburgh.

The Negative Absorption of Radiation.

IN Einstein's celebrated derivation of the Planck radiation formula, an equilibrium is considered to exist between three elementary processes: (1) a spontaneous emission from the atoms, (2) an absorption of energy by the atoms proportional to the energy density in the field, and (3) an induced emission of energy from the atoms, also proportional to the energy density. The third process can be described as a negative absorption of radiation, and is quite characteristic for Einstein's theory, as the omission of it from the equations leads to Wien's radiation formula instead of to Planck's. The negative absorption of radiation also figures prominently in the Kramers-Heisenberg theory of dispersion. The physical existence of such absorption has been up to now an article

[1] While the small number of controls is admittedly unsatisfactory, the failure of the gonads to develop may be considered conclusive in the light of other experiments, *e.g.* one in which the gonads, after having been brought almost to breeding condition in early January, were reduced again, by light reduction, to the winter condition in March. Thirty birds were involved in this experiment, and reaction was uniform.

of faith rather than a proved experimental fact, and indeed some writers (Ornstein and Burger, S. N. Bose) have been tempted to question its reality.

A definite experimental proof is now forthcoming of the reality of negative absorption. We have discovered (NATURE, April 21, 1928, p. 619) that when a liquid, for example, benzene, is irradiated by monochromatic light, the radiation scattered by the molecules contains several spectral lines of modified frequencies. Careful measurements have shown that the difference between the incident and scattered frequencies is exactly equal to an infra-red frequency of the molecule, so that the process of modified scattering involves the absorption of radiation by the molecule. As the molecule has several characteristic infra-red frequencies, we have an equal number of modified scattered lines. This is seen in the photograph reproduced in Fig. 1, which is from a

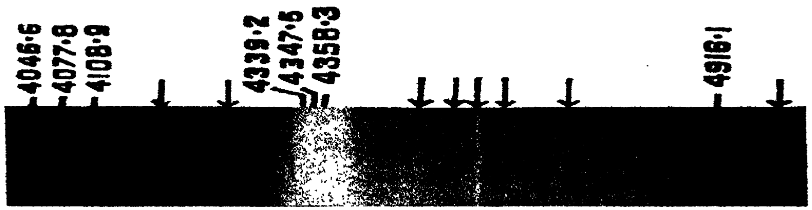

FIG. 1.

spectrogram of the scattering by liquid benzene, of the light of the mercury arc from which practically everything except the 4358 A. group of lines had been filtered out. In the spectrogram, the wave-lengths in the incident radiation are marked in A., and the modified scattered lines are indicated by arrowheads. (It may be mentioned in passing that the benzene had not been completely purified, hence a marked continuous spectrum is also present in the modified scattering.) The brightest modified lines are of longer wave-length than 4358 A., and their frequencies are determined by the infra-red absorption lines at $16{\cdot}55\,\mu$, $11{\cdot}78\,\mu$, $10{\cdot}10\,\mu$, $8{\cdot}51\,\mu$, $6{\cdot}27\,\mu$, and $3{\cdot}267\,\mu$. (These wave-lengths can be determined more accurately in this way than with an infra-red spectrometer.)

An inspection of the actual spectrogram, however, shows two modified lines of shorter wave-length than the exciting 4358·3 line, and the measurements show that their frequencies *exceed* that of the latter by the infra-red frequencies of the molecule, namely, those corresponding to $16{\cdot}55\,\mu$ and $10{\cdot}10\,\mu$ respectively. The presence of these lines proves simultaneously the existence in the liquid of molecules at levels of energy correspondingly higher than the normal, and the fact that the incident radiation induces a return to a lower state of energy; in other words, that there is a negative absorption of the radiation. The feebleness of the modified line of enhanced frequency, in relation to the modified line of degraded frequency, is consistent with the supposition that the transitions in either direction are equally probable, if we take into account the fact that the proportion of molecules in the liquid in a higher level of energy than the normal is small at the ordinary temperatures.

C. V. RAMAN.
K. S. KRISHNAN.

210 Bowbazar Street,
Calcutta,
May 15.

The Connexion between Dry-rot of Swedes in New Zealand and British Seed.

A RECENT paper by Cunningham ("Dry-rot of Swedes and Turnips: Its Cause and Control," Bull. No. 133, N.Z. Dept. of Agric., 1927) appears to show that the fungus which causes dry-rot (*Phoma lingam*) is carried by the seed of these crops. An examination of some of Cunningham's cultures, purporting to represent various strains of *Phoma lingam*, shows, however, that all his conclusions are not valid. These cultures were received through the good offices of Dr. Pethybridge, and were said to be transfers from cultures received direct from Cunningham.

Critical study of these 'strains' during the last month has yielded very surprising results, for several of them show no Phoma-stage at all, but produce spore-forms referable to the Moniliales and the Ascomycetes. Thus, Cunningham's 473 (IA) contains a fungus which, as judged by its conidia and conidiophores, is a species of *Macrosporium*. It differs obviously from the typical *Alternaria*, which, as Cunningham mentions, is an exceedingly common inhabitant of swede seed-coats. In addition to the Macrosporium conidia, this fungus produces very freely sterile enclosed fruit bodies, which an examination of the same fungus isolated from Irish sources has shown to be perithecia and not pycnidia.

The fungus (473—IA), as studied in comparative culture in repeated experiments on six different media, is identical in growth and colour reactions (including saltation), in its conidia and conidiophores, and in its other fruiting bodies, with a fungus isolated a number of times from swede seed in Ireland. The latter fungus produces (in addition to the conidia of a *Macrosporium*) numerous enclosed fruit bodies, which were found in a few cases to contain asci and muriform ascospores, of the type of *Pleospora*. Although hundreds have been examined, none has been found to function as a pycnidium. It has been grown from a single conidium, a single ascospore, and a single ascus, and the results in all cases are identical; in particular, the conidia and the fruit bodies have developed in each culture. Incidentally, it has been proved to be parasitic on swedes.

Similarly, Cunningham's 473 (IA) has been isolated from a single conidium in a number of cases, and on critical examination all the resulting cultures have proved to be identical with the original, both in their conidia and fruit bodies. Ascopores have not yet been found in 473 (IA), but we believe they will undoubtedly crop up there. This result appeared so surprising that it has been verified several times, and particular attention has been paid to the original culture, which contains both conidia and fruit bodies.

Similar conclusions have been reached concerning some of Cunningham's other 'strains' of *Phoma lingam*. While 503 (IA) and 533 (IA) (which are regarded as aberrant forms) appear to be species of *Phoma*, 488 (IB) is a species of *Alternaria*, and 505 (IB) is doubtful. The cultures representing Group II, 491B (IIA) and 596 (IIA), resemble closely isolations of *Phoma* made from rotting roots here. This is in agreement with Cunningham's conclusion that this group is chiefly responsible for dry-rot in New Zealand.

The net result of all this is that two of the five fungi sent by Cunningham to represent his Group I have been found to be species of *Macrosporium* and *Alternaria*, respectively; one is doubtful; and two are apparently species of *Phoma*. It is impossible to discuss here the question whether a Phoma-stage

ever occurs in *Macrosporium* or *Alternaria*, or the possibility that these latter stages have cropped up here in cultures which showed the Phoma-stage in New Zealand. It is safe to say, however, that *Phoma lingam* can have no other conidial stage unknown to all those who have worked on it, and that, therefore, the fungi in question have no connexion with this parasite.

The results now announced are particularly important to the British seed trade, which supplies swede seed to New Zealand. Their full import lies in the fact that, so far as one can gather from Cunningham's paper (p. 25), the parasite which is characteristic of English seed belongs to his group IA, and is apparently represented by his 473 (IA). Now this fungus is almost certainly not a *Phoma*, and without any qualification is not *Phoma lingam*. It is also, according to Cunningham, only weakly parasitic; and putting all the evidence together, it is obvious that *it* can have no possible connexion with the common dry-rot caused by *Phoma lingam*. Our own limited experience confirms the last two points; for a fungus identical with 473 (IA) is not uncommon on seed of Irish and English origin, while no true *Phoma* has been found on the 3500 seeds so far examined, which were drawn from seven different samples. It would be premature to suggest that *Phoma* never occurs there, but it appears to us likely that further study of the hibernation of this parasite, otherwise than on the seed, would be profitable.

I wish to acknowledge the great help received from the Imperial Bureau of Mycology in looking up the rather inaccessible literature of this subject.

PAUL A. MURPHY.

Albert Agricultural College,
Glasnevin, Dublin, June 12.

The Resistance of Pipes of 'Negative' Diameters.

IT is well known, from the results obtained by Stanton and Pannell, that the resistance, R, in dynes per square centimetre at the surface of a pipe of diameter d, carrying *any* fluid of density ρ, and viscosity μ, at a mean velocity v, is given by $R/\rho v^2 = f(\rho v d/\mu) \equiv L$, say. Prof. Lees has given a well-known formula for L, namely, $L = 0{\cdot}0763(\mu/\rho v d)^{0{\cdot}35} + 0{\cdot}0009$, and this function is accordingly sometimes known as Lees' function.

Considering this function recently for large values of $\rho v d/\mu$, which of course may be obtained when d only is large, it seemed evident that there could be no discontinuity in $R/\rho v^2$ when the curvature of the surface—which is $2/d$—passed through zero and became negative; that is, when the fluid changed from being on the concave side of the surface to being on the convex side.

Now $(\mu/\rho v d)^{0{\cdot}35}$ has no relevant analytic value for negative values of $\mu/\rho v d$; but it is quite different if the index, which was only empirically determined, was not 0·35 but exactly one-third. This led to the idea that probably the correct way of expressing L is as a rational function of $(\mu/\rho v d)^{\frac{1}{3}}$; and that the function found in this manner would be true for negative values of $\mu/\rho v d$ as well as for positive values.

Carefully measuring the ordinates of the middle of the band on Stanton and Pannell's well-known diagram, I found that the following simple equations represented the results with remarkable accuracy:

$$L = 0{\cdot}000635 + 0{\cdot}0725x \quad . \quad . \quad . \quad (1)$$

where $x \equiv (\mu/\rho v d)^{\frac{1}{3}}$, from $x = 0{\cdot}023$ to $x = 0{\cdot}052$; that is, from $\rho v d/\mu = 82{,}000$ to 7000 about; and

$$L = 0{\cdot}000635 + 0{\cdot}0725x + (0{\cdot}023 - x)^2 \quad . \quad (2)$$

from $x = 0{\cdot}023$ to $x = 0{\cdot}012$; that is, from $\rho v d/\mu = 82{,}000$ to 600,000.

For values of $\rho v d/\mu$ less than 7000, formula (1) begins to deviate owing to approaching the critical velocity. For viscous flow we have $L = 8x^3$ exactly.

Formulæ (1) and (2) agreed with the readings to within only slightly more than 0·00001, whereas the errors of Prof. Lees' formula varied systematically from 0·00006 positive, at $\rho v d/\mu = 160{,}000$, to 0·00006 negative, at $\rho v d/\mu = 10{,}000$. These divergences are of course small enough to be negligible for ordinary purposes. Formulæ (1) and (2) are much easier to use in practice than Prof. Lees' formula, as the cube root of $\mu/\rho v d$ can very readily be found on *any* slide rule, while the 0·35 power cannot.

The reason for putting forth new formulæ for L is not that a better fit is obtained, but because I believe L will pass through $x = 0$ into negative values of x without any discontinuity in either magnitude or slope; and I want to appeal for the experimental determination of L for negative values of x. This will entail finding the resistance to motion when long cylinders, of different lengths and pointed ends, are dragged axially through water at a depth of (say) ten times their diameter below the surface. This is obviously not work which can be undertaken in an ordinary university engineering laboratory owing to the size of tank required, but it could be done in a very short time in the Froude tank at the National Physical Laboratory.

It is almost certain that it will be found that L will pass through a minimum for a certain negative value of x, and then increase to a large value (probably ∞) as $x \to -\infty$. Formula (2) gives a minimum value of L of 0·000988 at $x = -0{\cdot}01325$; that is, at $\rho v d/\mu = -429{,}000$. In water at 50° F., at a speed of 10 ft./sec., this would give the diameter as just over seven inches.

The values of L, for what I have called negative values of $\rho v d/\mu$, may, for all I know, have been determined: if so, I should be grateful to have my attention directed to them. If not, I hope they will be determined owing to their scientific interest and the intimate connexion which exists between L and the transfer of heat from the surface to the fluid.

ALBERT EAGLE.

The University, Manchester.

X-radiation from Gases.

IN the years 1924–25 attempts were made by me at the Norman Bridge Laboratory of Physics, Pasadena, California, to get X-rays from gases by means of hot sparks, but without positive results (*Proc. Nat. Acad.*, **11**, 413; 1925). Since then I have been investigating some different methods of solving this problem. The method first used was the following:

A crucible with a 1 mm. hole at the top and containing a small piece of metallic sodium was placed in a vacuum and bombarded from above with an electron stream concentrated towards the hole in the crucible—that is, the top of the crucible corresponded to the target in an ordinary X-ray tube. In this way the crucible was heated; the sodium evaporated; and the vapour escaped through the hole and was hit by the electrons. The X-rays radiated from the vapour were revealed in the following way. Beside the crucible I fixed a screen of brass with a small hole covered with thin aluminium foil. On the other side of the screen I put a photographic plate, and in this way I obtained a picture of the crucible and of the space above it as through a pinhole camera. Exposures were taken when the crucible contained sodium as well as when it was empty. On the part of the plate corresponding to the vapour-beam, I

obtained an apparent blackening in the first case, which did not appear when the crucible was empty. This first experiment showed definitely that it is possible to get X-rays from a gas.

Later, I started to work with sulphur instead of sodium, and then I placed the crucible in front of the slit of a vacuum spectrograph in order to get a spectrum of the X-radiation. Using a gypsum crystal as a grating, and a strong electron current (about 60 milliamperes), I obtained a very weak line on the part of the plate corresponding to the $K\alpha$-line for sulphur. So far as I know, this is the first time an X-ray spectrum has been obtained with a gas as radiator. In order to be able to control the conditions better, I rearranged the apparatus. A small electric heater was fixed round the upper part of the crucible, and in this way the beam of vapour could be regulated independently of the electron current. The latter one was coming from the side at right angles to the stream of vapour. Using an electron current of 90 ma., a tension of about 6000 volts, and a slit 0·6 mm. wide, I obtained 5 lines on the plate after 2 hours exposure. The strongest two correspond to the $k\alpha$ and $k\beta$ lines. The three others, which are the most interesting, are so weak, though, that it is impossible to determine their wave-lengths. The work is being continued, and by some improvements of the apparatus I hope very soon to be able to increase the intensity so that the weaker lines as well will be measureable.

ALBERT BJÖRKESON.

Physical Institute,
University of Upsala, June 8.

Animal Diseases in Elizabethan Times.

WHILE looking up certain references for a paper now in course of preparation, I recently came upon some interesting data in Prof. E. A. Lewis's "The Welsh Port Books" (London, 1927), with regard to live-stock epizoöties in Ireland in the time of Queen Elizabeth.

As is to be expected, the Welsh Port Books record numerous importations of animals and animal produce from Ireland—plough-horses, cattle, wool, hides, etc., and of course considerable quantities of fish. But the most interesting items are those relating to the import of "murrain sheep skins." Totalling up these items for the period Michaelmas 1593 to Michaelmas 1594 (Port Book K.R. 1299/5), we find that no less than 15,100 "morkins" or "murren sheepskins" were imported from Ireland to the port of Milford. Again, we have a single cargo containing "2000 morkins being murren sheep skins"—that of the *Rioll Defence* of Milford, trading to that port from Ireland in May 1599. In March 1601 there were imported from Waterford to Milford 300 murrain sheep skins, and in July 1602, from Wexford to Milford, "100 murrain sheep skins and 250 murrain lambfell and kidfell." Altogether, therefore, during the ten years 1593–1602 there are records of the import of 17,750 "murrain skins" from Ireland.

The term 'murrain' has always covered a variety of epizoöties, including probably anthrax, foot-and-mouth disease, etc., and if in the present instance it includes cases of microbic diseases, the above throw an interesting light on possible means dissemination. But from the heavy incidence on sheep, and the absence of any reference to diseased cattle or other livestock, one may perhaps suggest that *Fasciola hepatica*, the sheep liver-fluke, was the main source of the damage. This parasite would of course always tend to flourish in such a wet country as Ireland, and especially in such a marshy and undrained Ireland as that of the sixteenth century. One of the earliest epidemics mentioned in history is that which appeared in Holland in 1552, and which Gemma called "lues infanda pecoris."

The matter is being investigated further, as it would seem to be of some importance in the history of animal diseases in Great Britain.

COLIN MATHESON.

Department of Zoology,
National Museum of Wales,
Cardiff, June 16.

Square Roots and the Decimal System.

IN NATURE of June 9, a correspondent, A. R., gives a method of James Thomson's for obtaining a series of convergents to a square root in the form of vulgar fractions.

A much more rapidly convergent set of values can be found by making use of the principle that if n is an approximation to the value of $\sqrt{N}$, then the expression

$$\tfrac{1}{2}\left(n+\frac{N}{n}\right)$$

is a much closer approximation. Thus we should find

$$\begin{aligned}\sqrt{6}&=\tfrac{1}{2}(2+\tfrac{6}{2})=\tfrac{5}{2}\text{ approx.}\\&=\tfrac{1}{2}(\tfrac{5}{2}+\tfrac{2}{5}\,.\,6)=\tfrac{49}{20}\text{ approx.}\\&=\tfrac{1}{2}(\tfrac{49}{20}+\tfrac{20}{49}\,.\,6)=\tfrac{4801}{1960}\text{ approx.}\end{aligned}$$

We thus get the series of convergents

$$2,\ \tfrac{5}{2},\ \tfrac{49}{20},\ \tfrac{4801}{1960},\ \ldots$$

as compared to the series

$$2,\ \tfrac{5}{2},\ \tfrac{22}{9},\ \tfrac{49}{20},\ \tfrac{218}{89},\ \tfrac{485}{198}\ \ldots$$

given by A. R.

The error in the value $\tfrac{4801}{1960}$ is less than *1 part in 18 million*, and this is obtained direct from the mere slide rule approximation of $\tfrac{49}{20}$ or 2·45. I have in practice found this to be much the most convenient way of finding a square root when the accuracy given by a slide rule is insufficient.

For cube roots the form

$$\tfrac{1}{3}\left(2n+\frac{N}{n^2}\right)$$

can be used in a similar manner.

From its simplicity one would have imagined that this method would have occurred to everybody who had often to extract roots, but except in Egypt (where I taught it myself) I have never met anybody who made use of it.

C. E. WOLFF.

The Gables, Hall Lane,
Mobberley, Cheshire,
June 10.

Can Crocodiles swallow their Food under Water?

RECENTLY I was touring the east coast of Lake Albert. At sunset one evening I saw a crocodile of medium size about 100 yards from the shore, very quietly and stealthily making its way toward the sandy beach. Having a telescope, I watched attentively, but to my surprise, when it grounded about 100 yards from me, it did not crawl out. It opened its mouth, disclosing a fish which I judged would weigh some 5 or 6 pounds, and proceeded to give it several vigorous bites before swallowing it head-first. This observation seems to suggest that the crocodile could not swallow the fish when submerged, else why did it take the trouble to swim to the shore with it?

G. D. HALE CARPENTER.

Entebbe, Uganda,
May 14.

Carriers of Electricity in the Atmosphere.[1]

By Prof. A. M. Tyndall.

THE nature of ions in air has been a subject of study for more than thirty years, but our information is still incomplete and a variety of phenomena still require elucidation. A certain amount of information on the nature of ions in the lower atmosphere may be gained from a study of their motion in an electric field. Except in special cases which rarely arise at ordinary pressures, the motion of an air ion through the air is analogous to the motion of a sphere falling through a viscous liquid. This motion is one of uniform velocity the value of which depends upon the radius of the sphere, the force acting upon it, and the viscosity of the liquid. For a given force and medium, the larger the sphere the slower it moves. This may readily be demonstrated in a syrupy liquid by dropping into it two balls, one of lead and the other of aluminium, their relative sizes having been selected so that they have equal weights in the liquid.

Similarly, ions in air possessing the same electric charge but having different sizes, will move in an electric field at different rates, the larger one travelling slower. There are theoretical grounds for supposing that this factor of size, though not the only one, is of great importance in determining the motion of the ion.

Some interesting effects may be obtained by adding small quantities of an organic vapour to the air. Let us take, for example, the series of normal alcohols of chemical composition $CH_3(CH_2)_nOH$, where n may be zero or an integer. The molecules of these substances are known to be rod-like in shape, the length of the rod increasing with increase in the carbon content, *i.e.* with the value of n. They are also known to be polar, a property presumably mainly due to the OH group made up of a positive hydrogen nucleus and a negative atom of oxygen. For the purposes of a rough static model, these molecules may therefore be thought of as having an active head and a more or less inert tail, and they will be attracted to a negative ion with their heads inwards towards the ion and their tails spread out radially. The effective size of the ion will thereby be increased by an amount which depends on the length of the molecules of the particular alcohol added.

Experiments by L. R. Phillips and myself have shown that for a given vapour pressure of alcohol the reduction in mobility of an ion increases rapidly with increase in length of alcohol chain. Thus the highest alcohol (amyl) used in this work, though present as only 1 part in 300 of air, reduced the mobility of the ordinary negative air ion to about 40 per cent of its normal value. The effect on positive ions is nothing like so marked, though it is observable. This may be attributed to a weaker bond between the dipole and a positive ion, because the positive end of the dipole cannot approach it so closely.

[1] Substance of a Friday evening discourse delivered at the Royal Institution on April 27.

By adding water vapour as well as alcohol vapour to the air, there is now a competition for places at the ion surface, so that short water molecules replace some of the longer alcohol molecules. We should on this view expect a rise in mobility of the ion, and this is observed.

If the molecules are made non-polar by removing the OH group and making them symmetrical in structure, the tendency to cluster on the ion should be almost entirely removed. This has also been confirmed by experiment, since it has been found that the hydrocarbon, decane, with ten carbon atoms and therefore roughly twice the length of the amyl alcohol molecule, has practically no effect on the motion of the ion in air.

New methods for measuring mobility have been devised with the special purpose of deciding whether all the ions move with the same speed. Considerable resolving power has been achieved. The negative ions appear to be of a single kind in air containing appreciable quantities of vapour. The positive ions over the same range and the negative ions in the presence of small traces of vapour appear to be complex. Certain features present themselves which are still the subject of investigation.

A lecture demonstration of the loading effect of alcohol may be conveniently made by applying a small voltage to an ionisation chamber so that the ionisation current is well below saturation. By blowing alcohol vapour into the chamber the current is reduced to about a half, due to the reduction in mobility of the ions conveying it. The ionisation current may be amplified by a valve method so that it is recorded on a galvanometer.

In the ordinary atmosphere, complicating factors are introduced by the presence of particles of dust, smoke, mist, and other nuclei. A number of small ions will attach themselves to these and will then move so slowly that their contribution to an ionisation current is practically negligible. In the demonstration referred to above, this may be readily shown by blowing tobacco smoke into the chamber, when the ionisation current to all intents ceases. In addition to the production of large ions by the union of small ions with nuclei, large ions may also be produced by the splashing and breaking up of water drops by frictional effects in dust storms and so forth. The presence of these large ions has marked local effects on the potential gradient at the earth's surface and the value of the air–earth current at a given place. Certain fluctuations in these values have been correlated with variations in the number of nuclei present.

When ions of a given sign are dragged through a gas by an electric field, they set the air in motion. With the relatively intense ionisation current from an electrified point this gives rise to the well-known phenomenon of the electric wind. One of the earliest methods of measuring the mobility of ions was based upon a study of this phenomenon.

Again, if a discharge of this type takes place in a smoky atmosphere, the electric wind assists in carrying the charged smoke particles towards the surrounding surfaces, where the particles stick on impact. In other words, it acts as a smoke precipitator.

To sum up, it may therefore be said that the subject of atmospheric ions has a bearing on at least two important problems at the present time. First, there is the problem of the mode and mechanism of attachment of molecules and ions, linking up with allied problems in the structure of bodies in general; and secondly, there is the wide field of meteorology and the problem of atmospheric electricity in particular.

Natural Steam Power in California.

By Dr. E. T. ALLEN and ARTHUR L. DAY,
Geophysical Laboratory, Carnegie Institution of Washington.

OF Prince Ginori Conti's remarkable experiments in utilising the potential power in natural steam, the readers of NATURE have been kept informed (121, 59–62; Jan. 14, 1928). The novelty of his conception and the patience and ingenuity with which it has been pursued to full realisation have attracted much attention among engineers and the public, and people have already begun to consider the possibility of similar projects elsewhere.

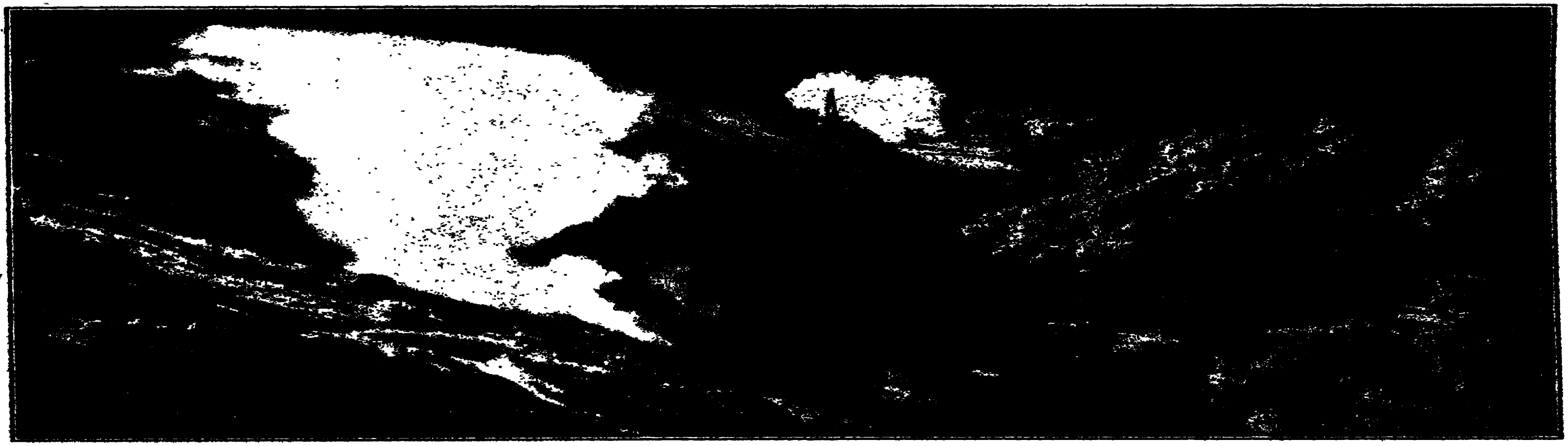

FIG. 1.—Sulphur Creek canyon looking east.

The locality in Tuscany which is the scene of those experiments has long been known as a centre of the boric acid industry, but few have had any definite conception of its character. It is, or rather was before industrial exploitation had modified its appearance, a barren tract covered here and there with very hot steaming springs and vents from which natural steam gushed out in jets of varying size—not infrequently with impressive noise and velocity. Exploration has since brought to light similar regions in other parts of the world, but the Tuscan field still appears to be unusual in the high proportion of its steam output.

Preliminary prospecting for natural steam with the drill in Bolivia and in Oregon has proved unpromising; the flow of steam was too feeble. In the Dutch East Indies one well, bored to a depth of 66 m., showed a pressure (closed) of $4\frac{1}{2}$ atmospheres and a potential power development of 900 kw. Other borings are contemplated in a number of fumarole areas in Java and Sumatra. The Valley of Ten Thousand Smokes, which has been mentioned in this connexion, is much too remote to claim consideration from a commercial viewpoint; besides, the most recent exploration in that region (1923) has proved that a great drop in the surface temperatures has occurred there in less than five years. The Italians have considered, and are perhaps still considering, the sinking of steam wells at Pozzuoli, near Naples, though we have not learned that actual borings have been made there. Recent advices from California inform us that a test hole drilled in Imperial Valley to a depth of 725 feet yielded steam at 175 lb. pressure; but the only development known to us that approaches the achievement in Tuscany has been carried out at The Geysers, a place 75 miles north of San Francisco and about 30 miles from the Pacific coast. It lies near the bottom of a deep V-shaped valley enclosed by steep mountain slopes, and reveals its presence to the approaching traveller as a barren stretch of ground from which on cold or damp

days great columns and clouds of steam are seen rising.

The hot ground which has been actually explored covers an area of only 35 acres. Where the surface is hottest the ground is absolutely barren, its desolate appearance being intensified in dry summer weather by salt encrustations—chiefly sulphates of magnesium and ammonium—which partially cover it. In less active spots a very sparse growth of grass and weeds may be seen, and in a few cooler places taller bushes and trees. Shallow hot springs, usually only a foot or two in diameter, yielding turbid water close to boiling temperature (which at this elevation is near 98° C.), are scattered over the surface, along the bottom and east side of the ravine. There are natural vents, never more than an inch or two in diameter, to be found here and there, but the steam that escapes from them, though frequently audible, is scarcely visible in the hot dry summers of California, save at morning and evening, when the observer finds to his surprise that it is not only pouring from the vents but is also seeping through the porous ground and enshrouding the mountain slope. A little below the surface the ground quickly reaches the temperature of boiling water, and in the two most active vents a surface temperature of 102° C. was measured.

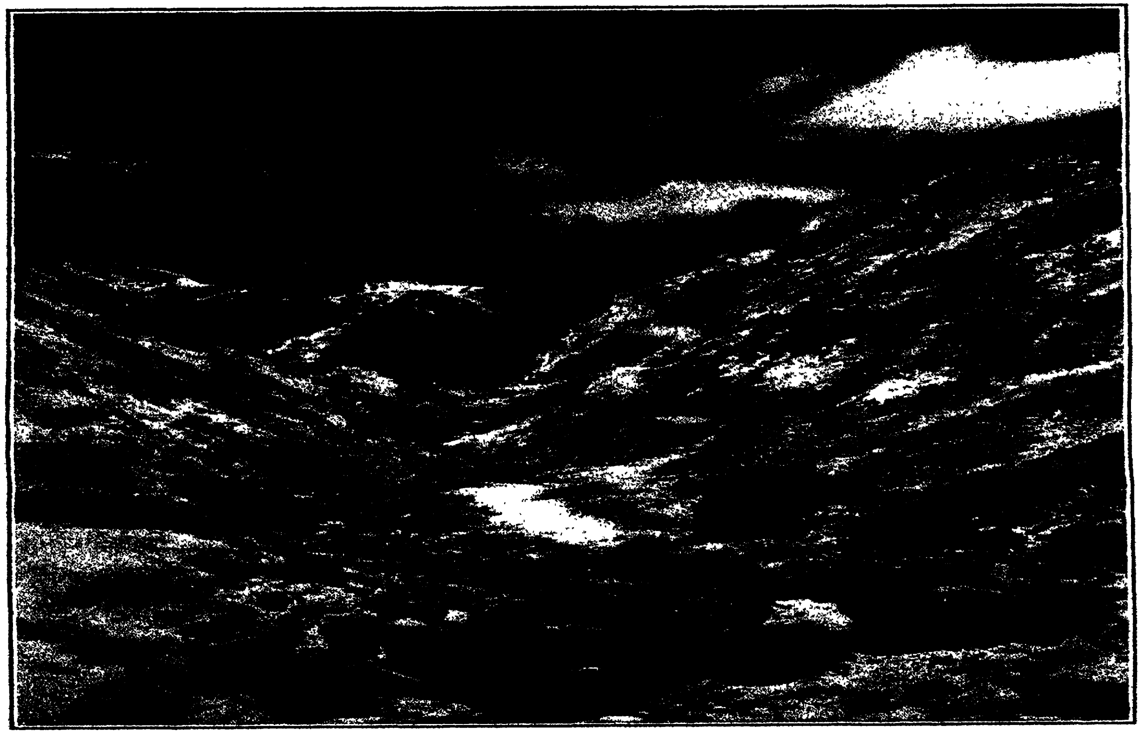

FIG. 2.—Geyser Creek canyon looking north at midday.

The Geysers has been known to the white man for about seventy-five years—a considerable period of time for that locality—but until recently it had attracted attention only as an unusual manifestation of Nature or for the reputed medicinal virtues of its hot-spring waters. About six years ago Mr. J. D. Grant, who has had considerable mining and prospecting experience, became interested in the constant escape of hot steam from the ground and, without any knowledge of the successful boring in Tuscany, conceived the idea of utilising it. Beginning in a small way with the help of a few men and an ordinary churn drill, he succeeded in drilling through the surface clay and into the underlying sandstone, keeping the steam condensed so far as possible by running in cold water from a tank on the mountain side. At intervals the rapidly heated water would shoot out like a geyser, after which more cold water would be let in. As soon as the hole had reached a suitable depth, an 8-inch steel casing was lowered into it and 'anchored' to the rock by the ingenious device of pouring around the pipe several hundred pounds of molten zinc, which congealed to form a tight joint.

It was about this time (midsummer of 1922) that we first visited the spot. Mr. Grant demonstrated the force of the steam by shutting off the cold condensing water and lowering the drill and tackle—representing a combined weight of about a ton—so as to cover the top of the pipe, when the whole mass was lifted several inches and the hot steam rushed out with a deafening roar. When the well had reached a depth of 200 feet the top was closed by a heavy gate valve. A second well was afterward drilled to a depth of 300 feet with power derived from the steam of the first well. Each of these two wells, when closed, developed a pressure of about 60 lb. per square inch. The practicability of utilising the steam was demonstrated by piping it to a small turbine and dynamo used for lighting the inn and cottages, the only buildings nearby.

Experimenting with the wells, Mr. Grant discovered that they would discharge continuously for a month, apparently without the least abatement of vigour, and, when closed again, would return to

[(Continued on p. 27.)

Supplement to NATURE

No. 3062 JULY 7, 1928

Modern Views on Combustion.

THE study of the combustion of gaseous mixtures and vapours of fuels in air has recently received considerable attention from physicists, chemists, and engineers, with special regard to the subject of detonation or knocking in the internal combustion engine. Two years ago, an important discussion on the subject of gaseous explosions, under the chairmanship of Prof. H. B. Dixon, was held in London under the auspices of the Faraday Society, when several valuable papers were read by eminent workers in this branch of science. Since that time, however, discoveries have been reported which throw new light on the mechanism of combustion and on the function of traces of water, lead tetra-ethyl, etc., on ignitibility.

Hexane burns in air or oxygen with the formation of carbon dioxide and water in accordance with the chemical equation

$$2C_6H_{14} + 19O_2 \longrightarrow 12CO_2 + 14H_2O + \text{heat of reaction};$$

but little was known of the mechanism whereby the atoms are rearranged to form new molecules. The isolation of aldehydes from the products of combustion of hydrocarbons led Profs. Armstrong and Bone to the well-known hydroxylation theory of the combustion of hydrocarbons, by which the oxygen atoms are assumed to become interposed between the carbon and hydrogen, forming dihydroxyl compounds which lose water and form aldehydes.

Recently, new ideas have been advanced with regard to the intermediate and initial steps of combustion, and these arose from extensive investigations on the cause of detonation. Thus, in papers by Prof. H. L. Callendar and the staff of the Air Ministry Laboratory, Imperial College of Science, evidence was given that the first step in the combustion of gaseous systems was the development of nuclei, either of ionised molecular aggregates or of small liquid particles condensed in the engine cylinder charge during adiabatic compression. These nuclei sensitise the gas mixture to self-ignition on heating by acting as centres of oxidation. The significance of ionisation on gaseous reactions has been shown by the interesting results of Prof. Bone and his co-workers, obtained during researches on the influence of the energy of the electric spark on ignitibility of dried gaseous systems. Still more recently, the work of Finch and Hodges, of the Imperial College of Science, has also shown that whereas moisture may accelerate combustion of carbon monoxide in a region of comparatively weak ionisation, it has little or no influence in a region of sufficiently intense ionisation.

The inhibitory action of traces of lead tetraethyl, iron carbonyl, thallium vapour, etc., is better understood by the explanation involving the provision of nuclei which are rendered innocuous by the attachment of molecules of the inhibiting substances. It is interesting in this connexion to recall the similar conclusions of Prof. Dixon and Lord Rayleigh with regard to the inhibition of phosphorescence by traces of ethylene and other organic vapours.

On the chemical side, Prof. Callendar and his co-workers concluded that the nuclear particles became centres of peroxidation, the collision of a fuel molecule with one of oxygen resulting in the formation of a highly reactive and explosive organic peroxide, for example, an alkyl hydrogen peroxide, by the direct incorporation of the oxygen molecule, rather than in the formation of hydroxyl compounds, which involves a separation of the oxygen molecules into atoms. The primary formation of peroxides accounts at once for autoxidation and detonation.

Autocatalytic action during the combustion of gaseous mixtures has also recently been reported by White (carbon disulphide), Hinshelwood (hydrogen), and others. The peroxidation in gaseous mixtures affords a link with the interesting work by Moureu and Dufraisse and others on the mechanism of inhibitors on the oxidation and polymerisation of liquid substances such as acrolein.

The careful studies by Egerton and Gates, an outline of which is given by Mr. Egerton in the following pages of our Supplement, of the action of a large number of organic substances and metallic vapours on the self-igniting temperatures of fuel-air mixtures, shed further light on the difficult problem of detonation and indicate the complexity of gaseous reactions.

Engine Knock and Related Problems.[1]

By Alfred C. Egerton, F.R.S., Reader in Thermodynamics, University of Oxford.

One hundred and thirteen years ago Sir Humphry Davy commenced his magnificent researches on flame, which paved the way for all subsequent work on combustion. It is interesting to remember that Davy specifically thanked Michael Faraday, then twenty-four years old, for "his able assistance" during that work. It was the practical aim to combat the dangers of firedamp in mines that supplied the incentive to Davy's work on combustion. To-day practical ends still supply the main incentive to research on combustion. In one way or another improvement of the internal combustion engine is the source of much of the work that is done.

Whether we like or like not the advent of the internal combustion engine and the changes it has wrought, no one can deny the human achievement it represents. It is only necessary to recall the nature of the cycle of operations, the high temperatures involved, the exact timing of each function, and the speed with which those functions have to be carried out.

Amongst the noises which this product of human enlightenment has bequeathed to us, we have what is called engine 'knock' or 'pinking.' 'Knocking' is a sound which comes from the cylinder during the abnormal explosion of the charge. It is to be distinguished from 'pre-ignition'—usually a duller sound—which is caused by explosion of the charge prior to ignition by the spark, and may in certain circumstances also arise. 'Knocking' limits the compression of the charge. The following figures will make clear the effect of compression of the charge on the efficiency of the engine:

Compression Ratio.	Theoretical Efficiency.	Gain of Efficiency.
4 : 1	42·6	—
5 : 1	47·5	11·0 per cent.
6 : 1	51·2	8·0 "
7 : 1	54·0	5·5 "
8 : 1	56·5	4·5 "

If the compression ratio were raised from 4 to 6 there would be a gain in efficiency of nearly 20 per cent. The efficiencies of actual engines are considerably less, something of the order of 30 per cent at 4 : 1, and 35 per cent at 6 : 1, or a gain of about 16 per cent in efficiency. Mr. Ricardo, whose work has so greatly influenced engine design, is of opinion that for engines of, say, 3 inches to 4 inches cylinder diameter the maximum practical efficiency would be given by a compression ratio of about 7 : 1, taking into account the mechanical forces developed, and the means adopted to withstand them. It is not possible to reach such pressures, because the behaviour of the petrol fuel limits the pressure. In an ordinary automobile engine, compression beyond about 4·5 : 1 leads to 'knocking,' and consequent loss of power and damage. By careful design it is possible to arrive at compression ratios of 5 or even 6 : 1, but only at the sacrifice to some extent of other convenience. This forced limitation of the efficiency of the engine is unfortunate as applying to the automobile, but still more so to the aeroplane.

The world's production of petrol is of the order of 12,000 million gallons per year. A gain of 20 per cent on the efficiency might save more than 2000 million gallons of petrol. Any opinion as to the reserves of petroleum is not to be hazarded, but it is sufficient to say that any factor which could save such vast quantities of valuable raw material must be very potent economically. ('Cracking' and recovery of light fractions has increased the quantity and improved the quality of the petrol obtainable from petroleum, but the improvement as to compression attained is insufficient.)

It has long been known that benzene, toluene, xylene, etc., added to petrol improve its qualities as regards 'knocking'—but to raise the compression ratio from 4·5 to 6 : 1 would require the mixture to contain about 50 per cent benzene by volume. The world's production of benzene, limited as it is by the production of coke, is only a fraction of that which would be necessary to add to petrol to make it possible to use, universally, high-compression engines. In an effort to find something more effective than benzene, Messrs. Midgley and Boyd, of the Research Department, General Motors, Ltd., tried many thousands of different chemicals and came across lead tetra-ethyl. Since, in a detonating explosion, the luminous and ultra-violet radiation is more intense, they thought that a substance absorbing radiation might possibly affect knocking. They were led, therefore, to test iodine; it was found to be effective, but not for the reason which suggested its trial, for bromine was found ineffective and chlorine even to induce knocking. They tried another neighbouring group of elements—tellurium, selenium, and sulphur—finding a similar relationship. Then, proceeding to try compounds in other

[1] Discourse delivered at the Royal Institution on Friday, May 25, 1928.

groups of elements which were soluble in petrol, such as tin and lead ethyls, they discovered the remarkable potency as an 'anti-knock' of the latter compound.

Many other substances, like diethyl telluride, or the unstable metallic carbonyls, behave similarly to a more or less marked extent. There are also organic products, such as the aromatic amines, which are effective, but about forty times as much would need to be added for the same effect as would be obtained with lead ethyl. It is not really satisfactory to give figures of effectiveness, as that seems to vary according to the circumstances of the test. The curve (Fig. 1) gives figures for the effect of small volume percentages of lead ethyl on the highest compression reached before knocking

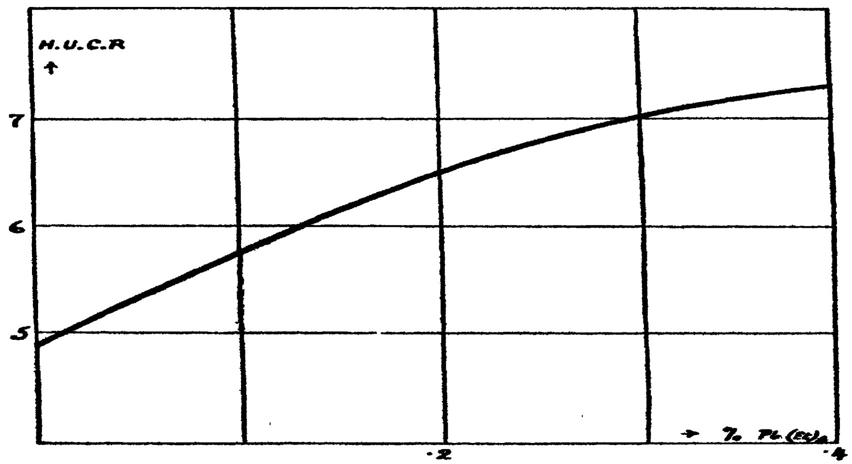

FIG. 1.

becomes audible, using a Ricardo variable compression engine. In Ricardo's engine the compression is varied by raising or lowering the whole cylinder, carburettor, camshaft and valve gear, the movement being measured by a micrometer screw. The engine is coupled direct to a balanced swinging field electric dynamometer. Another method of estimating the knocking characteristics of a fuel is provided by the fixed compression Delco engine, made by General Motors, Ltd. The extent of knocking is measured by a bouncing pin arrangement, the amount which it is bounced being measured by the volume of hydrogen generated during the time the pin closes an electrical circuit. The knocking character of a fuel can be compared against a standard fuel containing a definite quantity of anti-knock.

About one part of lead tetra-ethyl in 1500 parts of petrol (about 5 c.c. of ethyl fluid per gallon) will permit of the use of a compression ratio up to 6 : 1, and give an increase of at least 10 per cent in the power thereby. Furthermore, if all petrol were to be treated with such a 'dope,' it would be quite feasible from the point of view of supply, because it would entail about 40,000 tons of lead per annum, which is not more than 2 per cent of the world's production of that metal.

It is not the purpose of this discourse to enter into any controversial matters as to the poisonous character of ethyl lead or its effect on the engine. It is more interesting to consider 'why anti-knocks anti-knock?' Why should it be particularly interesting? The two remarkable points are the highly inflammable nature of the compounds which act as 'anti-knocks,' and the extraordinary small quantities required to be effective; 1 molecule of lead in 200,000 molecules of fuel–air mixture is definitely effective.

The Asiatic Petroleum Company afforded me facilities for investigating the problem, and I propose to outline the work as it developed from one stage to another. Discussion with Mr. H. T. Tizard led to the first line of attack. It was assumed that knocking in an engine—engine detonation—was akin to the setting-up of detonation in a gaseous mixture in a tube—a supposition later abandoned. The plan was to get an explosive mixture to detonate in a tube at a definite place, and then to find how the position would be altered by the presence of anti-knock. If the anti-knock delayed combustion, then the position of detonation ought to be further along the tube. Le Chatelier pointed out long ago the various ways in which flame can be propagated in an explosive mixture of gases. Depending on the conditions and the constitution of the mixture, flame may either be propagated with a uniform velocity by conduction of heat from layer to layer, or a vibratory type of combustion may be set up, or the flame may accelerate uniformly and finally detonate, if the strength of the mixture is above a certain limiting concentration. For the development of a detonation wave the gas in front of the explosion front must be heated by compression at least to its ignition temperature, and the rate of reaction must be so great that the fuel molecules are burnt before ever the compression wave has passed; combustion and compression then proceed simultaneously and with constant velocity. For example, the rate of travel of the detonation wave in an acetylene 1·5 oxygen mixture at normal pressure is about

2700 metres/sec. The photographic method, as developed by Prof. H. B. Dixon, was used in the investigations which Mr. Gates and I carried out on acetylene, pentane and hydrogen mixtures with various diluent gases.[2]

If the mixture is fired at the open end of a tube, the record of the travel of the explosion is very wobbly and detonation may occur at almost any place, but if the mixture is fired near the closed end of the tube, the explosion will be uniformly accelerated until detonation sets in, and it was found possible for given conditions (as to size of tube, etc.) to obtain detonation at a definite distance from the spark, and to study the effects of different diluent gases on the position of detonation.

Mixture + Diluent.	Position of Detonation.	Mixture + Diluent.	Position of Detonation.
C_2H_2 2·5O_2	cm.	C_5H_{12} 8O_2	cm.
3O_2	30	2O_2	12
3A	35	2A	34
3N_2	48	2N_2	50
3CO_2	98	2CO_2	62
3C_2H_2	53	2C_5H_{12}	80

Tube 0·9 cm. diameter. Pressure 760 mm.

It was found that anti-knocks did not influence the position of detonation (except in one or two cases, when the influence was to render the position earlier rather than later). These results have been confirmed by Lafitte working in Paris. At this stage a rather surprising negative result was all that had been reaped. It was necessary to go to conditions a little more like those in the engine—higher initial temperatures and higher initial pressures. For that purpose a long tube with a number of small glass windows was constructed; it could be heated electrically, and could withstand considerable pressures. It was found that, for a given mixture, increase of pressure diminished the distance from the spark at which detonation is set up, up to a certain limiting pressure, further increase having then very little effect.[3] (A similar effect of pressure on the *velocity* of the detonation wave is known from Prof. Dixon's work, and was confirmed.) Again, it was found that although initial pressures up to seven atmospheres and initial temperatures of 230° were reached, there was no effect of anti-knocks (such as lead ethyl or nickel carbonyl) on the combustion of such detonating mixtures.

[2] *Proc. Roy. Soc.*, 114, 137 and 157; 1927; and 116, 546; 1927.
[3] *Proc. Roy. Soc.*, 114, 152; 1927.

Fortunately, another line of attack was now open. Dr. Weerman[4] found that the igniting temperature of petrol, when dropped into a heated iron pot through which air was gently blown, was very considerably raised by the presence of anti-knocks. It was a curious result, for others had stated that

	Rise of Igniting Temperature.
	° C.
Selenium Diethyl	140
Iron Carbonyl	130
(Bismuth Triethyl	120)
Lead Ethyl	90
Nickel Carbonyl	40
Tellurium Diethyl	55
Bismuth Triphenyl	42

there was no such effect of anti-knocks on self-igniting temperatures—the difference was merely that air was used by Dr. Weerman instead of oxygen. We confirmed Dr. Weerman's results, and used the method to elucidate what was the seat of action of anti-knocks on the processes of combustion.

First, from a spark between lead electrodes, lead oxide was led into the igniting pot along with the air (see Fig. 2). It was ineffective, as is explained farther on. Then lead was brought in as metallic

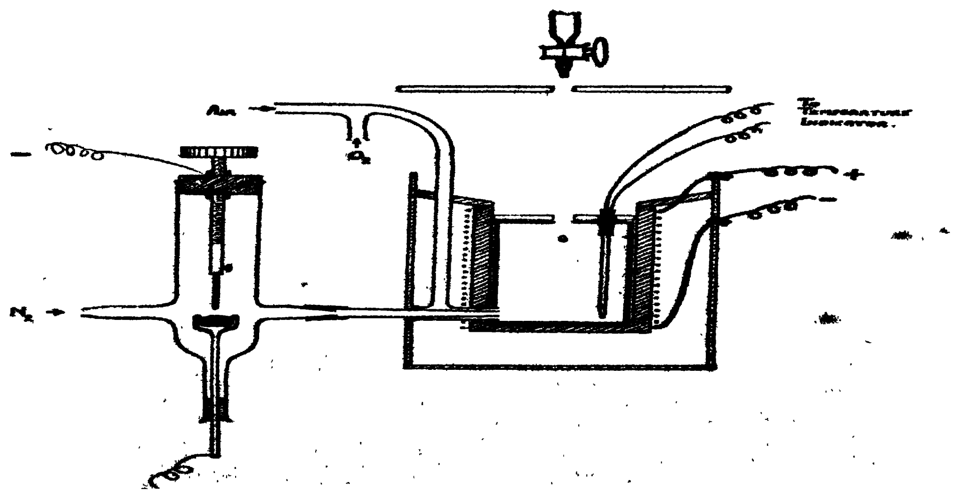

FIG. 2.

vapour from an arc in an argon stream, with immediate success—the igniting temperature was considerably raised, and to much the same extent

[4] *Jour. Inst. Petroleum Tech.*, 13, 61; 1927.

for a given amount of lead so introduced as when introduced as lead tetra-ethyl in solution in petrol. So the lead part of the molecule dissociated from the ethyl molecule was essentially the active constituent. This being possible with lead, other volatile metals could be tested (see table below),

TABLE 1.

Effective.	Ineffective.	Doubtful.
Thallium	Aluminium	Tin*
Potassium	Magnesium	Cerium*
Lead	Mercury	Vanadium*
(Iron)*	Iodine	Titanium*
(Nickel)*	Phosphorus	Zirconium
Manganese	Gold	Thorium*
Bismuth	Zinc	Tantalum
Selenium		Tungsten*
Tellurium		Chromium*
Sodium		Cobalt*
Cadmium		Uranium*
Calcium		
Antimony		

* Tested by other methods.

and so were traced the ignition inhibiting properties of many elements. Thallium was found the most effective. Potassium was, curiously, very effective —an illuminating fact. The potassium vapour, as soon as it meets the air stream, must become oxidised, so it must have been the oxide which was effective. But if it is brought into the air stream before reaching the pot, it is not effective. The explanation to this paradox seems definitely to be that the oxide is effective if it is there in a molecular condition, but if it has time to conglomerate into 'chunks' of oxide, it becomes practically ineffective. Many facts support this hypothesis. Following on this work Mr. Ricardo and Mr. Thornycroft ran an engine with an arc attachment, and found that, even if air instead of nitrogen was passed over the lead arc, it was still quite effective. In that case there was, no doubt, plenty of lead oxide in molecular condition, whereas in the preliminary experiments which we described with the spark in air which failed to give an effect, the lead oxide was probably already conglomerated.

Summarising results up to this stage, it is found :

(1) That anti-knocks do not affect a rapidly accelerating explosion in a tube.

(2) That anti-knocks influence igniting temperatures of petrol (in a current of air).

(3) That in every case an anti-knock effective in the engine influences igniting temperatures, though in some cases the reverse is not found.

(4) That it is the metal part of an organo-metallic anti-knock which is mainly instrumental in the action.

(5) That this metal atom must be in an incipient state of oxidation.

Although there are now some experimental facts to which to appeal, there are many questions to answer. Is there any property in common between the substances which have effect ? What is the function of the anti-knock when it raises the temperature of ignition in the igniting vessel ? In what stage of affairs in the engine does the anti-knock have effect, and why, if it does not influence the rate of a detonating explosion, does it influence combustion in the engine cylinder ?

As to the first question, those substances which act as anti-knocks have, it seems, the common property that a state of equilibrium exists at the temperature at which they operate between certain products of the anti-knock. Thus, in the case of potassium, the oxides K_2O_3 and K_2O_4 have been shown to exist in a state of equilibrium in favour of the higher oxide at 400°. If the higher oxide is reduced to the lower, it can be regenerated by the next suitable impact with an oxygen molecule. It seems to be this property which renders such a small amount of metal effective ; as soon as some has had effect it is regenerated in an active condition.

Similarly with thallium, lead, bismuth, and manganese, such figures as there are for the oxide equilibria support the hypothesis. The metals zinc, magnesium, etc., are ineffective, for no such transformation is possible. The case of selenium is interesting ; the same sort of change may take place perhaps as occurs with sulphur compounds such as glutathiones in physiological oxidations. Some organic substances such as aromatic amines act as anti-knocks, though to a feeble extent compared with metallic compounds ; their behaviour also agrees with the suggestion that their activity is due to the formation of fairly stable oxidation products. In support of this we find quinone to be effective. These organic anti-knocks were shown to undergo combustion themselves at the temperature they are required to operate, so that the chance of their effective action is very much reduced.

The next question was, What do the anti-knocks do to the vapours which would ignite ? A study of the behaviour of a large number of inflammable substances in the igniting pot and the effect of anti-knocks of various kinds upon them has been made.* Anti-knocks definitely slow down the rate of reaction prior to ignition, as curves showing the temperature rise indicate. This result was con-

* *J. Inst. Petroleum Tech.*, 13, 61, 251; 1927.

firmed by measurements of carbon dioxide produced, and, by Dr. Weerman, of oxygen absorbed. In the language of the chemist; the anti-knock is an 'inhibitor of oxidation.' Then comes the question, Is it in the body of the gas or on the surface of the vessel that the anti-knock has its effect? Davy demonstrated that surface combustion occurs in circumstances where flame cannot be set up. From a variety of observations we have come to the conclusion that ignition starts, not at the surface, but in centres of high energy in the body of the gas. The anti-knock delays combustion not specially at the surface, but by inhibiting the rate of oxidation prevents the setting up of these centres. If the surface-volume ratio of the ignition vessel is increased, the effect is to raise ignition temperature. If the anti-knock were to increase the activity of the surface, the effect indeed might be to raise igniting temperature; but it was not found that the effect of the anti-knock was proportional to the extent of surface.

If the effect of an anti-knock on a range of compounds is studied (see table below), it may be

TABLE 2.

Substance.	I.T.	Rise with $PbEt_4$.
Benzene	690° C.	18° C.
Cyclohexane	535	27
Methylcyclohexane	470	92
Pentane	515	75
Isohexane	525	46
Heptane	430	83
Petrol (Shell)	460	82
Ether	440	65
Alcohol	515	(9)
Acetaldehyde (iron vessel) .	395	110
,, (silica vessel) .	350	170
Pentane	540	87
Amylacohol	490	Nil
Amylenehydrate	640	35
Valericaldehyde	320	380
Dimethylaniline	445	Nil
Carbon Disulphide	120	Nil

noted that the combustion of normal paraffin hydrocarbons (which are those constituents of petrol that are most prone to knocking), is more inhibited than that of naphthenes, for example, such as cyclohexane. Further, there is a very remarkable inhibition of the combustion of aldehydes. Prof. Bone showed long ago that aldehydes are intermediate products in the combustion of hydrocarbons. One would be led to suppose that this is the seat of the action of anti-knocks, the further oxidation of the aldehyde being delayed. That must be so, but it is not the whole story. Let us assume that it is so, that the anti-knock or inhibitor acts only on the aldehydes in the course of the hydrocarbon oxidation and delays their oxidation. The amount of the aldehyde will then increase in the products of combustion. That is the opposite to what is found. Therefore to retain our hypothesis it could be suggested that the products of oxidation of the aldehydes hasten the initial hydrocarbon oxidation—a process of autoxidation. The consequence of such an addition to the hypothesis would be that considerably enhanced combustion should occur on addition of aldehydes to hydrocarbons. That is also not found to be the case to any marked extent. We have then to discard the hypothesis.* The inhibitor must be acting elsewhere besides. Suppose, then, that it also inhibits the initial oxidation of the hydrocarbon. Here, again, there is a difficulty. The quantity of inhibitor is insufficient to control the simple interaction of oxygen and hydrocarbon molecules. It must then be concluded that it acts on certain products of the primary oxidation of the hydrocarbon which tend to hasten (autocatalyse) that initial oxidation. Such is the argument by which we are guided to a general view of the process of combustion of a hydrocarbon.

Suppose some fuel molecules are amongst oxygen and nitrogen molecules in a vessel the temperature of which is gradually rising. The molecules primarily pick up their energy from the walls. It is the walls that control affairs at first, and reaction only occurs at the walls at first. Sufficient of the fuel molecules in the body of the gas may, however, gain momentarily sufficient energy to unite with an energetic oxygen molecule with which they happen to encounter. Prof. Callendar and his associates have investigated this temperature of initial combustion. It means essentially that a temporary peroxide is formed—a peroxide in a high energy state possessing the energy of activation of the fuel and oxygen and also potentially the reaction energy.

Several things may happen to this active addition compound of fuel and oxygen. (*a*) It may revert to a normal state and radiate energy in so doing, and form a stable peroxide. Peroxides are indeed found amongst products of combustion and of oxidation of organic compounds (as Wartenburg, Staudinger, Callendar, and Mardles and others have shown). (*b*) The compound may break up again, the parts being less active by the energy radiated. (*c*) The compound may reorganise and give highly active products, thus for ethane:

$$CH_3-CH_3+O_2 \longrightarrow CH_3-CH_3\,.\,O_2 \longrightarrow CH_3\,.\,CHO+H_2O$$

* The reason for this lack of effect is probably that the concentration of the aldehyde is not great enough to transmit the reaction chain.

(Dihydroxyethane may possibly also be formed to some extent as an intermediate stage in the production of the aldehyde and water.) (*d*) Collision may occur. Encounter with inactive nitrogen molecules may result merely in frittering down the energy of the active product, but encounter with a fairly active fuel molecule, or product thereof, or oxygen molecule, will raise its energy so that it will react and produce active products. These products in turn may collide and activate other fuel molecules, and so on, a reaction chain mechanism being set up; in the above case of ethane,

$$CH_3-CH_3+O_2 \longrightarrow CH_3CHO+H_2O,$$

the active aldehyde and/or water molecules being able to communicate their energy to activate other ethane molecules, and so on.

A rare occurrence thus becomes a frequent occurrence locally. This explains the setting up of centres of high energy in the body of the gas, indicated as necessary for ignition to occur. Any influence that tends to decrease the local concentration either of fuel or oxygen molecules or to dissipate the energy may break the chain of reaction, and so enormously affect the rate of oxidation. Once a chain mechanism is established, local free energy increases, and molecules can be excited into higher energy states, and in returning from those states can give out light. So it is that luminescence can be observed during combustion of hydrocarbons many degrees below their igniting temperatures. Further, as the mean temperature approaches the igniting temperature, the state of excitation becomes sufficiently intense to ionise a proportion of the molecules, actual inflammation being attended with more or less intense ionisation. Some sort of solidity is derived in support of the view put forward in that Dr. Bäckström,[7] working in Sweden, has found that the thermal oxidation of liquid aldehydes is essentially a chain reaction. More important still, Mr. Hinshelwood[8] can best explain his recent measurements of the rate of reaction of oxygen and hydrogen in terms of a reaction chain mechanism. The effect of the surface of the vessel in breaking the chains is indicated, and seems to be in accord with the observation before mentioned that increase of surface raises igniting temperature.

Returning now to the anti-knocks, it is established that they inhibit oxidation. They evidently act by breaking the chains. That, together with the chance of regeneration already mentioned, is sufficient to account for the small quantity of the 'dope' required. Perhaps they break the chain because reaction between metal peroxide in a molecular condition and active fuel peroxide occurs with mutual destruction and rearrangement, the resulting products having much less energy than they would possess had the fuel peroxide encountered another active molecule—the reaction, for example,

$$H_2+H_2O_2 \longrightarrow 2H_2O$$

liberates much more energy than the reaction

$$H_2O_2+PbO_2 \longrightarrow PbO+H_2O+O_2,$$

so that the water produced would be on the average less active in the latter case, and could not communicate sufficient energy to continue the reaction chain. Anti-knocks are not so effective in presence of high concentration of oxygen, for then the reaction chains are too easily propagated for their inhibition. Catalysts such as nitrogen or chlorine peroxides promote autoxidation by providing highly active products on reaction

This question of the behaviour of anti-knocks has led deep into the processes of combustion; enough has been said to indicate that much more work must be done before the detail is known to any degree of certainty.

Finally, we come to the third question, In what stage of affairs in the engine do the anti-knocks have effect, and why, if they do not influence the rate of a detonating explosion, do they influence combustion in the engine cylinder?

When it had been shown that anti-knocks delay oxidation, Mr. Ricardo ingeniously arranged a test whereby it was found that preliminary oxidation during the compression stroke was much less when inhibitors were present than when they were not present. (This conclusion was likewise arrived at by Prof. Callendar and the Air Ministry Staff.) It was clear that anti-knocks act on the gaseous charge in the stage prior to ignition (and prior to inflammation at the flame front), and delay the initial stages of reaction in the manner already discussed.

Now, in front of a flame travelling along a tube there is a narrow region—a fraction of a millimetre in thickness—in which the gas is becoming heated to such a temperature that reaction is rapid enough for inflammation to be set up. Such a temperature is the ignition point in the circumstances in which the gaseous mixture there finds itself. There is a further rapid rise of temperature within the flame front due to the combustion of the mixture. If one knew all about the reaction velocity, the thermal conductivities, specific heats, and ignition

[7] Cf. the important experiments of Moureu and Dufraisse on autoxidants.
[8] *Proc. Roy. Soc.*, 118, 170; 1928.

point, under given conditions of loss of heat, it ought to be possible to calculate the flame velocity. Such data are not complete, but it can be realised at once that any influence which delays matters in the 'heating up' zone will influence the rate. Furthermore, since the zone is exceedingly narrow, it is clear that any inhibitor 'will have to be quick about it' if it is going to have any effect, particularly if it has first to be decomposed and rendered in an active condition. When once in the zone of combustion, there is so much heat available that the inhibitor can have very little effect—in fact, the organic radicals which form part of the molecule go to add to the heat developed by their own combustion, and tend even to hasten matters; so it is that one can explain the negative results obtained in the detonation experiments, and the absence of effect when gases are suddenly ignited from the cold by adiabatic compression.

Some experiments have been made to test this conception. Comparatively slow flames in pentane mixtures of concentration similar to that used in engines, when photographed in a bomb, were shown to be slower when lead ethyl was present.[9] The uniform speed of flames in tubes could also be modified to some extent with pentane mixtures. These effects were particularly marked for vibratory flames, for then as the flame moves forward it decomposes and oxidises the lead compound, and on its return conditions are more favourable for the lead to be effective as an inhibitor. Using carbon monoxide or methane flames, no effect was observed with lead ethyl, but with the more easily decomposed iron carbonyl the rate is considerably modified. A 50 : 50 air–carbon monoxide (wet) mixture will burn with a blue flame at a rate of about a yard a second; exactly the same mixture containing $\frac{1}{1000}$th part by volume of iron carbonyl burns with a brightly luminous flame very much more slowly.

Photographs have been taken of explosions in acetylene and in pentane mixtures at about engine strength in a cylindrical bomb (19 cm. × 10 cm.) fitted with three windows, ignition being started in the centre of one of the endplates. When audible knock occurred, the photographs showed a check in the rate of combustion after the second window. Prof. Wheeler points out that this is probably due to cooling of the flame front as it meets the walls.[10] Vibrations in the flame are also visible. Dr. Fenning, at the National Physical Laboratory, has recorded the pressure effects in explosions of a knocking character in various mixtures at various temperatures in a similar bomb. Prof. Wheeler and Dr. Maxwell have also taken a number of beautiful photographs of this kind.[11] Their results indicate that in a knocking type of explosion a sudden vibratory and enhanced combustion occurs in the neighbourhood of the walls, which may lead to a compression or shock wave passing back through the products of combustion. It is not a 'detonation wave.' It is more "like a great flame which creates noises within the air" (Leonardo da Vinci).

Knocking appears to be due to inequality in the condition of the charge set up, particularly in regions of high pressure and temperature, as in the neighbourhood of hot exhaust valves. This inequality provides regions of high energy, containing molecules in high energy states, where reaction can spread more quickly. Unequal burning gives rise to a vibratory condition of flame. Any influences, such as a higher state of turbulence or cooler surfaces, or more even and longer combustion space, which tend to prevent sudden and local rise of pressure, and the setting up of centres of high energy, tend to prevent knocking. Anti-knocks, such as lead ethyl, by inhibiting the processes of combustion which we have seen to occur in those centres, are therefore effective in preventing knocking. Furthermore, they have been rendered effective by the temperature and oxidation to which they and the charge are exposed during the compression stroke; the charge in the engine cylinder is so affected by its previous exposure to oxidation during compression that the opportunity for the flame to meet regions in a high state of energy is greater than when those previous oxidations have been appreciably inhibited by anti-knocks or other factors.

Prof. Callendar has directed attention to the importance of the presence of nuclei—small droplets of unevaporated fuel—in the charge in the engine cylinder. A discussion of this aspect of the subject cannot be entered upon here. The concentration and energy of the molecules of vapour at the surface of an evaporating droplet, and the rate of oxidation at the surface of the droplet, are such as greatly reduce the temperature of ignition. The tendency to knock would likewise be enhanced. But it is also certain that knocking is possible in completely vaporised mixtures, and that anti-knocks will affect the temperature of ignition of completely gaseous fuels. A more general viewpoint is adopted in this discussion of engine-knock and the problems that relate thereto.

We have come now to the end of our story—not, though, to the end of an investigation. Thinking again of Davy's researches on flame—of the questions, How does a flame start? What prevents it starting? What occurs at the surfaces exposed to the ignitable gases? we see the horizon of the unknown ever widening. We will quote from the opening remarks of Faraday's lectures on the Chemical History of a Candle, "So abundant is the interest that attaches to the subject, so wonderful are the varieties of outlet which it offers into the various departments of philosophy. There is no more open door by which you can enter to [illegible]l philosophy than by considering the physical phenomena of a candle."

[9] *Proc. Roy. Soc.*, **116**, 516; 1927.
[10] *Proc. Roy. Soc.*, **116**, 516; 1927.
[11] *J. Inst. Petroleum Tech.*, Feb. 1928. See also Duchesne, *C.R.*, **186**, 220; 1928.

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the same pressure as at first. With the aid of outside capital the work was continued under a competent engineer, Mr. J. D. Galloway, of San Francisco, who completed five new wells ranging from about 400 to 650 feet in depth and developing pressures (when closed) from 95 lb. to 276 lb. per square inch. Further measurements showed a steam output for the individual wells of 7500 to 52,000 lb. per hour (average above 30,000 lb.), corresponding to a switch-board delivery (average) of about 1000 kilowatts per well at a pressure of 75 lb. The wells are separated by distances varying from 50 feet to 175 feet, and none of them appeared to show any diminution in pressure or flow of steam due to the output of its neighbours.

The figures show that the steam wells here are fully equal to those in Tuscany in point of power developed, and that they contain a somewhat smaller percentage of fixed gases to diminish the effectiveness of the application of the steam to power development. On the other hand, the chances for extension of the power development appear much more limited. While the hot ground in Tuscany is said to cover an area of about 100 square miles, thermal activity in the Californian locality is confined to a narrow belt less than a quarter of a mile in width and not more than six miles in length, and even within this area hot water and steam appear at the surface only in places. In Tuscany, too, there is an added commercial advantage in the boric acid supply; in California the percentage of boric acid in the gas is small. But the industrial outlook is not unpromising; the operating company has under consideration at the present moment a plan for the appropriate utilisation of the power. Of the scientific interest of what has already been accomplished there can be no doubt whatever.

In the summers of 1924 and 1925 we were permitted to make quite a large number of tests on five of the seven wells—all that were completed at the time. Analyses showed that the steam was accompanied by other gases varying in amount from three-quarters of one per cent to a maximum of two per cent by volume. These gases are mixtures of carbon dioxide—always the chief constituent—and smaller amounts of hydrogen, methane, hydrogen sulphide, nitrogen, argon, and traces of boric acid and ammonia (about 0·03 per cent). A series of temperature and corresponding pressure measurements in the closed wells showed that the former ranged from about 154° C. to 190° C. at the top, while pressures varied from 62 lb. to 180 lb. per square inch. The most powerful well, as a matter of safety, was kept partially open during the time of these experiments, discharging at a pressure of about 120 lb. per square inch. Without taking time to analyse the figures,[1] it may be said that they prove conclusively the superheated character of the steam. Nasini had already reached the same conclusion regarding the natural steam of Tuscany. A wider experience has proved that this is not a sporadic occurrence in thermally active ground; we have found vents in the Yellowstone Park, in the Lassen National Park, and many in Alaska, where the temperature of the escaping steam was so high as to leave no doubt of superheat.

The facts would probably convince any competent observer that the source of the steam in the wells under discussion could not be derived from a reservoir of water, either above or below ground. The high temperature, high pressure, enormous output, and superheated character of the steam point to hot magma below the surface, of such extent that the steam may be drawn off in quantity for an indefinite time without materially diminishing its pressure. Only a hot magma, probably still near its crystallisation temperature, could answer these requirements. We know that water is an invariable constituent of all types of igneous rocks and that there is more of it in the glassy rocks which approach in character nearer to the liquid state. We know also that the gases associated with the steam both in the wells and in natural vents correspond in character to those found in igneous rocks, varying only in their relative proportions from place to place as other rock constituents do.

The area where these steam wells are located is superficially covered with sediments and meta-

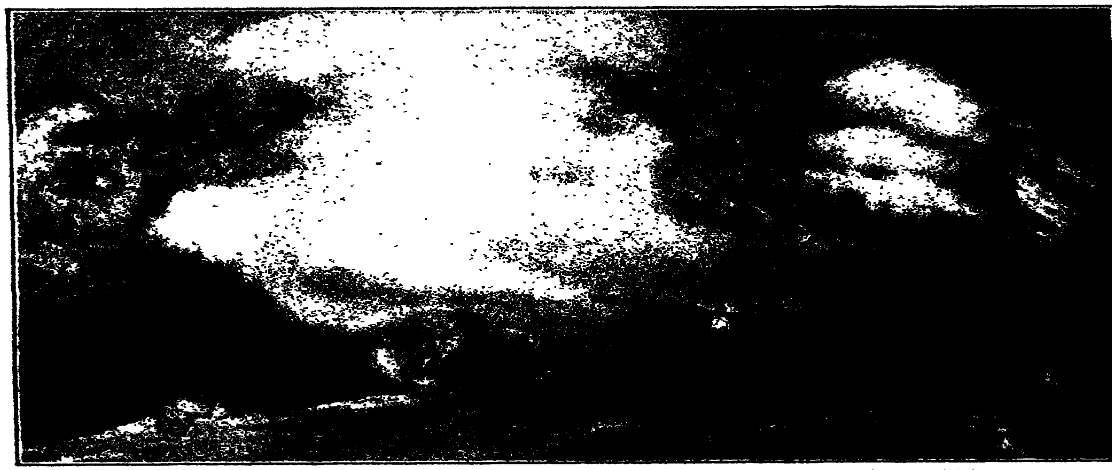

FIG. 3.—Wells No. 1 and No. 2 discharging into the atmosphere, 1924.

[1] For details see "Steam Wells and Other Thermal Activity at 'The Geysers,' California." E. T. Allen and Arthur L. Day, Carnegie Institution Publication No. 378 (Washington, D.C.: Carnegie Institution), pp. 56 seq.

morphics, but a core of gabbro was brought up from a depth of 230 feet in drilling one of the wells, while andesite outcrops on the higher peaks of the mountain range. With the incomplete evidence at hand it would appear that the rock from which the steam issues is not recent, for the sediments are apparently of Cretaceous or Jurassic age. The view here presented concerning the source of the steam assumes the existence of a fault—a means of egress for the imprisoned steam. Of that we have interesting evidence in the fact that within a narrow belt, more than 25 miles in length, many quicksilver mines as well as all the hot areas are found. However, every theory of hot springs assumes the existence of faults to account for their appearance at the surface, and the association has been proved to be true in so many instances as to inspire some degree of confidence in its general validity.

Obituary.

PROF. T. W. RICHARDS, FOR. MEM. R.S.

THE death of Prof. T. W. Richards on April 2, at the comparatively early age of sixty years, is a grave loss to science. His contributions to knowledge were so valuable and cover so wide a field that it is impossible here to do more than indicate their scope: yet it is not difficult to grasp the secret of his greatness. He once quoted, as an expression of his own views, Plato's saying that "if arithmetic, mensuration, and weighing be taken away from any art, that which remains will not be much." All that Richards did testifies to his belief that the development of natural knowledge is primarily dependent upon measurement.

It was in precision of measurement, not only of atomic weights but of many other properties of matter, that Richards far outstripped his fellows. To read any of his papers is to see that he would spare no effort to ensure the maximum attainable accuracy in his data. His attention was directed to work on atomic weights through the influence of J. P. Cooke (himself a pupil of Regnault), who worked on the ratio of oxygen to hydrogen and undoubtedly did much to inspire Richards' interest in chemistry. Shortly after graduating at Harvard in 1886, Richards began work on the atomic weight of copper, and in the next few years he developed the essential features of the new technique for the determination of halide ratios upon which many of his subsequent researches depended. Successively assistant, instructor, and assistant professor in the Department of Chemistry at Harvard, he was appointed professor of chemistry in 1901, and chairman of the Department in 1903.

During this period, with the frequent collaboration of his colleague, Prof. G. P. Baxter, he was actively at work, and when, in 1912, he became director of the Gibbs Memorial Laboratory at Harvard, he had already redetermined the atomic weights of more than thirty important elements. By a critical survey of the researches of Stas, and especially by the continual criticism and development of his own methods, Richards, at tremendous cost in thought and labour, achieved that essential simplicity which is the mark of genius. The obvious importance and interest of his work attracted many able research students, by whom his methods and ideas have been widely disseminated; and, more significant still, it inspired and guided not a few who had never seen him.

Richards investigated the balance and developed improved methods of weighing; he invented the nephelometer and ascertained the conditions in which it can be used to determine precisely traces of dissolved salts and to indicate the end-point of a silver titration. He demonstrated the insidious effect of occluded moisture and gases in solids, to avoid which he invented the so-called 'Harvard bottling apparatus,' with which it is possible to fuse and resolidify a salt in any desired atmosphere and then transfer it in a dry, inert gas to the closed vessel in which it can be weighed. It was Richards who first applied the centrifuge to facilitate the purification of salts by fractional crystallisation, and he showed how Stas' results had been vitiated by the solubility of oxygen in silver and developed a procedure by which really pure silver could be prepared.

Richards' methods are well exemplified in his monumental work with Willard on the ratios of silver and silver chloride to lithium chloride and perchlorate. By taking advantage of the high proportion of oxygen in the perchlorate of a metal of low atomic weight, a very accurate ratio of silver to oxygen was obtained, and this served to establish, in relation to the fundamental value $O = 16{\cdot}000$, really precise and trustworthy values for the atomic weights of silver and chlorine, and the best available value for the atomic weight of lithium.

In later years Richards played his part in the development of modern views of the atom, and we owe to him some of the most accurate determinations of the atomic weight of lead from radio-active sources, and also the only precise evidence yet available that the molecular volumes and the molecular solubilities of isotopes are identical.

Though it is by his work on atomic weights that Richards is best known to chemists, he made many other valuable contributions to knowledge. A study of atomic and molecular volumes led him to formulate the theory of the compressible atom. He observed that the same atom might occupy different volumes according to its state of combination, and concluded that atoms were compressible, and that in compounds they were, in fact, compressed by the forces of chemical affinity. Though this conception seems to us to-day to be simple, natural, and readily intelligible, it was, when propounded, a revolutionary notion which was quite generally discredited. By it, however, Richards was led to carry out a most valuable series of measurements of compressibilities of

elements and compounds, in which again he had to develop, test, and apply entirely new experimental methods. The results, of value in many ways, afforded strong confirmation of his basic hypothesis. In later years, Richards's interest centred chiefly upon these problems of atomic and molecular volumes and compressibilities, and, though he was active in many other fields, he undoubtedly regarded this as his most important work.

These are but a few examples of the methods and data by which he enriched the physical sciences. He made most valuable contributions to precise thermometry and calorimetry. We owe to him the proposal to use the transition points of pure compounds as fixed points in thermometry, and it was at Harvard that the methods of adiabatic calorimetry were first developed and applied. He also greatly increased the precision of determinations of surface tension and obtained the standard data for many important liquids.

This recital of Richards's achievements should be greatly extended and amplified, but enough has perhaps been said to indicate how fundamental and extensive they were. Their value was generally recognised, and the honours that fell to him are, like his works, too numerous to detail. Many American and foreign universities honoured him and themselves by the award of degrees. He was a foreign member of the Royal Society, an honorary fellow of the Chemical Society, before whom he delivered the Faraday Lecture in 1911, and he received in turn the Davy Medal, the Franklin Medal, and the Le Blanc Medal. Many other American, British, and foreign scientific societies similarly honoured him, and in 1914 he was awarded the Nobel prize for chemistry. He was an active member of numerous societies and committees, and served as president of the American Chemical Society, of the American Association for the Advancement of Science, and the American Academy of Arts and Sciences.

We mourn in Richards a great and kindly man who was a great chemist: his place is marked by the cairn of exact data he raised with his own hands.

H. V. A. BRISCOE.

DR. W. A. YOUNG.

DR. W. A. YOUNG, Director of the Medical Research Institute, Gold Coast, while engaged on investigations connected with yellow fever, contracted the disease and died on May 30 at Accra. His death is peculiarly tragic in view of his early age, and of the fact that two other investigators have died in West Africa in like circumstances within a period of a few months. It is believed that he became infected while making a post-mortem examination on his colleague, Dr. Noguchi, whose death was referred to in our issue of June 9 (p. 914).

William Alexander Young was born in 1889, graduated M.B., Ch.B. (St. Andrews) in 1911, and after holding the office of house surgeon at the Halifax Royal Infirmary and studying tropical medicine at the Liverpool School, joined the West African Medical Service in 1913. He was first stationed in Sierra Leone, and during the War served with the Cameroon Expeditionary Force (1915–16). In 1920 he was transferred to Nigeria and appointed assistant bacteriologist. From June to December 1923 he was attached to the Nigerian Tse-tse Fly Investigation staff, and was part author of the second report prepared by that body. He was then transferred to the Gold Coast on appointment as pathologist, and in September 1924 was promoted to the directorship of the Medical Research Institute.

Young's interests in the field of tropical medicine were wide, and the subjects of his publications remarkably diverse. His papers, most of which appeared in the *Transactions of the Royal Society of Tropical Medicine and Hygiene*, the *Journal of Tropical Medicine and Hygiene*, and the *West African Medical Journal*, deal with blackwater fever, leprosy, trypanosomiasis, plague, dysentery, and yellow fever. He was equally at home in the laboratory and in the field, as instanced, on one hand, by an experimental work on the effects of emetine (carried out during a period of leave in collaboration with G. R. Tudhope), and, on the other, by a detailed survey of the tse-tse fly conditions in the Gold Coast. His aim, in view of his position as Director of Medical Research, was to maintain a good knowledge of many subjects, rather than to concentrate for a long period on one.

When it was suggested that Noguchi should come to Accra, Young, who was then giving most of his attention to yellow fever, accepted the suggestion with enthusiasm, and at once began preparations for work on a larger scale. Soon after Noguchi arrived, Young volunteered to assist him, and the two worked together until the end.

Young applied himself with zeal to administrative duties. On his initiative the staff of the Medical Research Institute at Accra was considerably increased, and an additional laboratory was opened at Sekondi. He also designed and had fitted locally a very efficient motor laboratory. In his dealing with his subordinates, both European and native, he was very considerate and tolerant, appreciative of achievement and forgetful of errors, and both European and native will miss him greatly.

WE regret to announce the following deaths:

Prof. A. A. Breneman, consulting chemist and chemical engineer, editor (1884–93) of the *Journal of the American Chemical Society*, who carried out work on explosives, water analysis, etc., aged eighty-one years.

Dr. W. M. L. Coplin, emeritus professor of pathology and bacteriology in the Jefferson Medical College, on May 29, aged sixty-three years.

Prof. E. M. Crookshank, emeritus professor of bacteriology at King's College, London, on July 1, aged sixty-nine years.

Dr. William H. Nichols, Jr., vice-president of the Allied Chemical and Dye Corporation and a past president of the American Chemical Society and of the American Society of Chemical Industry, known for his work on the metallurgy of copper, on May 28, aged seventy-six years.

Sir John Isaac Thornycroft, F.R.S., a pioneer in the design and construction of small high-speed vessels, on June 28, aged eighty-five years.

News and Views.

THIS week Lord Sydenham of Combe, soldier, administrator, and publicist, celebrated his eightieth birthday, and the occasion enabled many friends to proffer their congratulations. Born on July 4, 1848, Lord Sydenham (formerly Sir George Clarke) was educated at Haileybury and the Royal Military Academy, Woolwich. In 1868 he entered the Royal Engineers, afterwards seeing much active service, and earning a reputation as an authority on military matters. He had also made a special study of fortification, in regard to which he wrote (1910) a well-known treatise. From 1894 until 1901 he was superintendent of the Royal Carriage Factory, Woolwich, vacating this post on becoming Governor of Victoria. He was raised to the peerage in 1913; and further, in 1917, designated G.B.E. Taking a keen interest in public affairs, Lord Sydenham became chairman of the Royal Commission on Contagious Diseases, 1913–15; afterwards president of the National Council for Combating Venereal Diseases. He was president of the British Science Guild from 1917 until 1920. He had been elected a fellow of the Royal Society in 1896. Last year Lord Sydenham published an interesting reminiscent book, entitled "My Working Life."

RECENT events indicate that the movement for calendar reform is making progress, and that not in regard to Easter only, but in the direction of some of the more far-reaching proposals which were included in the report of the late Committee of Inquiry of the League of Nations as calling for careful consideration, though without any definite expression of opinion on the part of the Committee as to their respective merits. One event of great importance is the passing of a resolution at the meeting of the U.S. National Academy of Sciences at Washington on April 23 last, favouring "a change in the present calendar, looking to the establishment of 13 months per year, grouped so that the last 13 days of June and the first 15 days of July form the proposed new month, the odd 365th day being designated as 'Year day,' and the extra day in leap year being designated as 'Leap Day,' and permitting among other things the establishment of a fixed date for Easter Sunday." Another significant circumstance is the adoption by Standing Committee No. 3 of a resolution for submission to the annual plenary Congress of the League of Nations Societies being held at The Hague during the past week, which, though not specifying any particular proposals, directs attention to the defects and inconveniences of the existing calendar, and "invites the League of Nations Societies to urge the Governments of their respective countries to take immediate steps to expedite the convening by the League of Nations of an International Conference entrusted with proposing specific measures for the reform of the calendar."

IT is evident that the work of exploration already done under the ægis of the League of Nations is being vigorously followed up by those eager for reform, but it seems likely that much resistance will be offered, especially perhaps in European countries, to the specific proposals approved by the U.S. National Academy of Sciences. The suggestions relating to 'Year Day' and 'Leap Day' have been opposed by certain powerful religious communities, and it will probably be long before chronologists and the majority of people can be reconciled to the substitution of a 13-months for the time-honoured 12-months year. It is always open to any business organisation to arrange its affairs on whatever system it finds convenient, without the general disturbance in so many departments of social life which the suggested radical change would involve. It is, however, of great importance that the questions at issue should be thrashed out by competent bodies in all countries, in order that objections raised may be met and, if possible, removed. The activity displayed by those anxious to reform the calendar is accordingly to be welcomed, but it is necessary to guard against hasty and insufficiently considered action.

As radio receiving sets are now often connected with public or private supply mains so as to obviate the trouble and expense of the charging and maintenance of accumulators, it is advisable that there should be some supervision of the apparatus supplied by radio manufacturers for this purpose. Without this supervision there may be, in exceptional cases, risk of fire or even risk to life. Regulations for the design and installation of this class of apparatus have now been issued by the Institution of Electrical Engineers, with the approval of the Radio Manufacturers' Association. The cases containing them must be made of metal or non-ignitible material, or various kinds of specified woods. All holes for the passage of cables must be made so as to avoid abrasion of the cables. When a conducting material is used for the containing case it must be earthed. The temperature of the air inside the containing case must not exceed 120° F., and the apparatus must be adequately protected by fuses. A novel rule is that when radio apparatus is connected with direct current supply mains the aerial must have only inductive connexion with the apparatus through a transformer or condenser. With alternating current supply mains the capacity of the connecting condenser must not exceed 0·001 of a microfarad. Head telephones and loud speakers must be connected with the radio apparatus through a transformer or through a circuit which includes a condenser. Insulation resistance tests which the apparatus must pass are also specified. These regulations should render the new radio apparatus quite safe without appreciably increasing its cost. They do not apply to radio apparatus, such as a crystal set, which is not connected with the mains. Even in this case, care has to be exercised in installing the devices when the building is wired for the electric light. Shocks have been received when using headphones or when handling apparatus connected with the earth owing to the operator accidentally touching at the same time a portable metal lamp standard, an electric heating or cooking appliance, a metal switch

or similar device, owing to it having accidentally become 'alive' due to the development of a fault in the electric wiring.

SENATORE MARCONI and G. A. Mathieu have recently developed a multiplex system of radio communication, using short waves. We learn from Marconi's that experiments made at the Marconi beam station at Bridgwater have been completely successful. Music has been sent from Montreal, using the same apparatus and aerials as those through which two simultaneous Morse telegraph messages were being sent. The music was received at full strength and the quality was excellent, so that the Bridgwater party could dance to the strains from across the Atlantic. There was no hint of Morse interference, and it was impossible to tell that the music of the dance band was being transmitted from Canada on the same radio circuit as a high-speed 'dot and dash' service. The Bridgwater receiving station was built by the Marconi Company in 1926 for the General Post Office, which gave permission for the present experiments to be made. The new apparatus enables all the beam stations equipped with it to deal with three times the amount of work they can do at present. As some of the present simplex stations are working almost to their full capacity, this new invention is a very timely one. Instead of having only one channel of communication between each transmitter and receiver, it will be possible to use at least three. An appreciable economy in working will therefore be effected. Empire broadcasting at a comparatively low cost is also rendered possible. When equipped with multiplex apparatus the Empire beam stations can transmit broadcasting at the most suitable time for any part of the Empire without in any way interfering with the ordinary commercial services. It is claimed that with the new apparatus the effects of 'fading' are considerably diminished. At the present time the multiplex equipment at the Canadian beam station near Montreal and the receiver at Bridgwater are the only instruments in use. It is hoped, however, that in a few weeks' time multiplex working between England and Canada will have been achieved.

DURING the daytime many thoroughfares in London are choked with vehicles, and extensions or repairs of underground cables and pipes have become almost impossible. In addition, new services make it necessary to dig deeper and deeper in order to get an unobstructed passage, and the modern practice of laying wood blocks on a concrete foundation makes excavation very difficult. The loss also entailed on the public, and especially on shopkeepers, when excavations are in progress is serious. The London Traffic Act of 1924 has done good work by appointing a permanent committee as a co-ordinating authority. The only logical plan appears to be to construct subways or tunnels under the footways or roadways or both, which will accommodate in an orderly and readily accessible manner the plant at present laid in a haphazard manner over the whole of the roadway. This is the plan which E. S. Byng advocates in *World Power* for April. Although subways were constructed in London nearly sixty years ago, yet their development has been very slow. The Post Office, however, has made some useful subways. In Paris, the very extensive system of tunnels and galleries built under the main boulevards has proved of the greatest value to public utility companies. In Madrid there is a useful system of underground canals which is largely utilised. Twenty years ago, sixty miles of tunnels were constructed under the main thoroughfares of Chicago at considerable expense. They are 7½ feet high by 6 feet wide, and are lined with concrete. As a general rule, American cities have not adopted subways, but in Los Angeles and other places the engineers are being forced by the increase of traffic to consider their possibilities. It would be advisable to widen the powers of such bodies as the London Advisory Committee so as to enable them to provide for both present and future requirements.

THE centenary of the birth of Eduard Suess, the illustrious author of "Das Antlitz der Erde," is to be commemorated in Vienna, where for half a century he was professor of geology, by the erection of a public monument. British geologists will welcome an opportunity of celebrating the occasion, for throughout the world the brilliant work of Suess has been a source of inspiration to his admirers during at least two generations. Moreover, the name of Suess will always be intimately linked with England, since it was in London, at 4 Duncan Terrace, Islington, that he was born in 1831. The council of the Geological Society of London has had the happy thought of paying a fitting tribute to his great services to geology by placing a memorial tablet on the house in which he was born. The permission of the owner of the house and of the local authorities has already been obtained, and fellows who may wish to contribute to the cost, which will amount to about ten guineas, are invited to send a small subscription (not exceeding five shillings) to the Secretary of the Geological Society, Burlington House, W.1.

BEFORE and after the British Association meeting at Glasgow there are to be geological excursions, led by the president and local secretary of Section C (Geology). The numbers going on these excursions are necessarily limited, but there are still a few vacancies. One excursion (Aug. 30–Sept. 5) led by Mr. E. B. Bailey, is to Ballachulish and Fort William to see the cauldron subsidences of Glencoe and Ben Nevis, recumbent folds and slides of Ballachulish and Fort William, and the parallel roads of Glen Roy. This visit has been arranged to help the Discussion of "Highland Problems" which appears in the programme of the meeting. The other excursion is to Arran (Sept. 12–19), to see the schists, Highland border rocks, Old Red Sandstone, Carboniferous, New Red Sandstone, and the Tertiary igneous complex. It will be led by Dr. G. W. Tyrrell, whose Geological Survey Memoir on the district is expected to be published before the meeting. Applications to join these excursions should be made to

Dr. G. W. Tyrrell, Geological Department, University, Glasgow.

IN recent years the Royal Scottish Museum in Edinburgh has made great progress in the display of its valuable collections both from an educative and an artistic view-point. The Report of the Director for the year 1927, issued from the Scottish Education Department, recounts further advances, the most interesting being the opening, on the occasion of a visit paid by Her Majesty the Queen, of a British Bird Hall in a new block, mainly destined for the development of the natural history department. The early opening of three new galleries, devoted to comparative ethnology, technology, and mineralogy, is foreshadowed. Educational activities bulk largely in the report. Daily demonstrations were given on subjects pertaining to art and ethnography or to natural history; lantern lectures and gallery demonstrations arranged by the Education Authority of Edinburgh were given to 2456 school children; a series of loan cases of natural history specimens for the aid of nature study is circulating in primary and secondary schools; and on one occasion the Museum was specially opened at the request of a party of 1400 Nottingham miners on their way to a football match in Glasgow, so that they might visit the Mining Hall. Many interesting and valuable specimens were added to the various collections by gift and purchase throughout the year, and the scientific importance of the cabinet collections of natural history has been appreciated by many experts. It is regrettable that a Museum visited by 468,504 individuals in the course of the year should have to complain of the poor sale of its post cards and descriptive publications.

DR. J. B. ORR, of the Rowett Research Institute for Animal Nutrition, Aberdeen, and Sir Arnold Theiler, formerly of the Veterinary Research Institute, Onderstepoort, South Africa, have been making a careful study of pasture and stock problems in Australia. Unfortunately Dr. Orr's visit has been only a brief one, but Sir Arnold Theiler will spend six months in the Commonwealth. Problems of pasture improvement and animal nutrition generally are being taken up by the Council for Scientific and Industrial Research, and it is hoped as a result of Dr. Orr's presence to arrange for the utmost co-operation between workers there and in other parts of the British Empire, particularly at Aberdeen. The question of how best to organise tropical agricultural research work in Australia or adjoining territories has been under discussion between the Council and the Empire Marketing Board for some time, and Dr. Orr's observations will no doubt weigh considerably with the Board when a decision comes to be made. The policy of the Council towards veterinary research will be based largely upon the recommendations to be made by Sir Arnold Theiler.

SIR JOHN RUSSELL arrived in Australia towards the end of May and was met by a formidable programme, designed to enable him to see as much of agricultural development and research as was possible in a limited time. Between the lectures which he has delivered in the capital cities at the invitation of the universities, he has visited all readily accessible places of interest, particularly in the irrigation areas of South Australia, Victoria, and New South Wales. The progress of these areas is of much importance to Australia from the point of view of her immigration policy, and the scope and need for scientific work are immense. Sir John will endeavour to arrange for close association between the Council for Scientific and Industrial Research and the Imperial Soils Bureau, the institution of which at Rothamsted was recommended last October by the Imperial Agricultural Research Conference.

AT the annual meeting of the Royal Society of New South Wales, held on May 2, Prof. J. D. Stewart delivered his presidential address on "The Application of Science to the Sheep Industry." He pointed out that it is essential for the prosperity of Australia that the pre-eminence of this industry be maintained by further development. Many of the problems of the pastoral industry are primarily due to the physiographical characteristics of Australia, its topography, climate, and variability of rainfall. Increase in sheep population alone will not advance the industry very far, unless certain conditions retarding progress are better controlled and improved methods of production are more actively stimulated. Some of the more important problems and weaknesses of the industry, including the control of drought by fodder and water conservation, longer range weather forecasting, and increased facilities for transportation were then discussed. The wide field that exists for investigations in animal nutrition was mentioned; the Council for Scientific and Industrial Research is already taking action in this matter. Research in animal genetics and a more scientific study of wool are also necessary. Attention was also directed to the control of pests by biological methods, and to the suppression of animal diseases by further research, and the better organisation of veterinary effort. The proposal of the Wool-brokers and Wool-growers and the Pastures Protection Boards (N.S.W.) to raise funds for research in problems of the sheep industry, shows that the industry is willing to assist in the investigation of causes that retard its development.

THE eighth Annual Report of the Industrial Fatigue Research Board (to Dec. 31, 1927) again illustrates the value of systematic inquiry into problems of national importance. The variety of the problems investigated under the direction of the Board is as remarkable as the success which has attended them. Researches in progress, briefly described in the report, include the physiology of ventilation, accident causation, the relation of age to the acquisition of dexterity, the problems of vocational guidance, the design of machinery in relation to the operator, sickness among cotton weavers, card-room operatives, and printers, weight carrying by women and load carrying by men, atmospheric conditions in mines, telegraphist's cramp, and methods of vocational selection. The results obtained from investigations so far completed are broadly reviewed and the conclusion is stated that

"the increase in rate of output on short shifts, the beneficial influence of short rest pauses, the importance of high illumination in fine processes, the disadvantageous effects on work involving muscular effort at high temperatures, have been repeatedly indicated in so many investigations . . . that they can be accepted as established within a high degree of probability and *ripe for experimental application on a large scale under practical conditions.*" Another interesting investigation mentioned is that in which the effects of menstruation were studied. The results showed that "this strictly physiological phenomenon has, as a rule, no appreciable effect on working capacity amongst normal healthy women." Glimpses of the methods of investigation employed, as well as a brief summary of the results obtained, are also to be found in this report.

SOME criticisms of the use of airships in the Arctic have been made by Dr. W. Bruns, secretary of the new International Society for the Exploration of the Polar Regions by airship, known as Aeroarctic, which, according to a recent *Daily News Bulletin* issued by Science Service of Washington, D.C., is organising a polar expedition for next year in LZ127, the giant airship now being completed at Friedrichshafen. The small size of General Nobile's airship not merely prevented the carriage of equipment requisite for a forced landing, but also seriously limited the cruising radius. This limitation of radius, with the low-speed of the *Italia* (about 53 miles per hour), necessitated a base in Arctic regions exposed to the vagaries of Spitsbergen weather. The German expedition proposes to have a base outside the Arctic at Leningrad, and others at Murmansk and Nome, away from the unsettled conditions of the North Atlantic, and hopes for a cruising radius of about 8000 miles for its airship.

AN exhibition of maps illustrating the cartography of the British Empire was opened at the Science Museum, South Kensington, on June 28, and will remain open until the end of October. The exhibition has been arranged in connexion with the International Geographical Congress which meets this month in London and Cambridge, and the conference of Directors of Survey in the Dominions and Colonies. Most of the maps selected are those in current use, but the Ordnance Survey is showing a series of sheets illustrating the successive editions of the one-inch map from 1801 to the present day, and the Hydrographical Department of the Admiralty is contributing a number of charts from the eighteenth century and a series of charts of the Downs from 1795 onwards. An exhibit has been arranged to illustrate from various parts of the world the stages through which map making has passed. There are examples of the sailing chart of the Marshall Islanders, wooden relief maps of the Greenland Eskimo, a world map from about 700 B.C., and several reproductions of medieval maps. Sixteenth and seventeenth century maps are also represented. In an adjoining gallery there is an exhibition of modern surveying instruments. Catalogues of the exhibition are available.

ON Thursday, June 28, at a reception held at the Ross Institute and Hospital for Tropical Diseases, Putney Heath, the Harben Gold Medal of the Royal Institute of Public Health for 1928 was presented by the Viscount Leverhulme, honorary treasurer of the Institute, to Sir Ronald Ross, in recognition of his eminent services to the public health.

IT is announced in *Science* that Congress has adopted a resolution providing for the striking of a gold medal commemorative of the achievements of Thomas A. Edison, and the presentation of the medal to Mr. Edison by Congress.

BARON FERENCZ VON NOPCSA, of Vienna, and Prof. Frederico Sacco, the distinguished palæontologist of Turin, have been elected foreign members of the Geological Society of London. Dr. W. J. Jongmans, of Heerlen (Holland), and Señor Don César Rubio y Muñoz, of Madrid, have been elected foreign correspondents of the Society.

THE Eastman Kodak Research Laboratory at Rochester, N.Y., is recognised as one of the foremost in the world, and has been responsible for many important scientific and industrial developments in relation to photography. It is under the directorship of Dr. C. E. K. Mees. A research laboratory in London is to be developed on similar lines, as part of the Kodak factory organisation at Harrow, and will be under the direction of Dr. Walter Clark, of the Science Museum, South Kensington. Dr. Clark is a graduate of University College, London, and was for five years with the British Photographic Research Association. He is honorary secretary of the seventh International Congress of Photography being held this year.

THE Research Association of British Paint, Colour, and Varnish Manufacturers has issued the first number of a *Review of Current Literature relating to the Paint, Colour, and Varnish Industries.* The review is arranged in a convenient form and should prove to be of great service to all those connected with these industries.

A HANDBOOK to Tasmania was prepared for the members of the Australian Association for the Advancement of Science on the occasion of its meeting in Hobart in January this year. There are chapters on different aspects of natural science by various Tasmanian authors. Particular attention may be directed to those on geology, botany, and forestry. There are also useful chapters on hydro-electric development, manufactures, and education, and a candid and thoughtful economic survey of the past and present. A coloured geological map and some excellent photographic views are bound with the volume.

MESSRS. Watson and Sons, Ltd., 313 High Holborn, W.C.1, have issued a catalogue of photomicrographic and projection instruments, which includes some useful hints for the beginner on photomicrography.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the engineering department of the Hull Municipal Technical College—The Director of Education,

Education Offices, Guildhall, Hull (July 11). A demonstrator in the physics laboratory of the Royal Naval Engineering College, Keyham, Plymouth—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (July 12). An assistant to the head of the Plant Disease Research Division of the Ministry of Agriculture for Northern Ireland, and an assistant to the head of the Ministry's Dairy Bacteriology Research Division—The Secretary, Civil Service Commission, 15 Donegall Square West, Belfast (July 14). Junior assistants at the National Physical Laboratory, Teddington—The Director, National Physical Laboratory, Teddington (July 14). Two geologists on the Geological Survey of Great Britain—The Director, Geological Survey and Museum, 28 Jermyn Street, S.W.1 (July 14). A mycologist at the Royal Horticultural Society's Gardens—The Director, Royal Horticultural Society's Gardens, Wisley, Ripley, Surrey (July 16). An assistant professor of physics at the Military College of Science, Woolwich—The Assistant Commandant, Military College of Science, Red Barracks, Woolwich, S.E.18 (July 21). A fellowship for research work in connexion with aeronautics—The Clerk, The Company of Armourers and Brasiers, 81 Coleman Street, E.C.2 (July 28). A mechanic to take charge of the college workshop, and laboratory stewards for the chemistry and physics departments of the University College of Hull—The Secretary, University College, Hull (July 29). A second in command to the Chief of the Economic Botany Division of the Commonwealth Council for Scientific and Industrial Research—The Acting Secretary, Commonwealth Council for Scientific and Industrial Research, 314 Albert Street, East Melbourne, Victoria (Aug. 31). An investigator for work on the Flying Fox (*Pteropus spp.*) problem in Australia—F. L. McDougall, Australia House, Strand, W.C.2 (Aug. 1), or The Acting Secretary, Commonwealth Council for Scientific and Industrial Research, 314 Albert Street, East Melbourne, Victoria (Sept. 1). A part time professor of highway engineering at the City and Guilds Engineering College—The Academic Registrar, University of London, South Kensington, S.W. 7 (Sept. 4). Lecturers in applied chemistry and in economic entomology in the University of Queensland—The Secretary, Queensland Government Offices, 409 Strand, W.C.2. A lecturer in mining subjects at the Mansfield Technical College—The Principal, Technical College, Mansfield. A lecturer in chemical engineering at University College, London—The Secretary, University College, Gower Street, W.C.1. A woman laboratory assistant with knowledge of botany, physics, and chemistry, at Bedford High School—The Head Mistress, High School, Bedford.

Our Astronomical Column.

TELESCOPES OF THE FUTURE.—It seems very possible that certain innovations may be made in the construction of telescopes. Larger aperture seems required without much additional weight; the solid, thick disks for reflectors are difficult to cast, mount, and utilise in an efficient manner, and atmospheric disturbances affected their performance in no small degree. For general work, the really large instruments have been often discarded for smaller sizes by Herschel, Rosse, and Lassell, being found more serviceable and expeditious.

Prof. G. W. Ritchey, of Pasadena, California, who has worked for some time in Paris, had a considerable share in the making and mounting of the 100-inch reflector at Mount Wilson and has experimented with several instruments of large size. He concludes that "future optical mirrors will be made not of solid disks but built up of glass plates; light, cellular structures, cemented together and figured at high mountain sites" where they are intended to be employed. He says that he hopes to make a reflecting telescope with a practically perfect mirror 50 feet in diameter. He describes details of his project in the *Journal of the R.A.S. of Canada* for May-June, 1928, and expresses himself with confidence in regard to the realisation of his plans.

Prof. Ritchey's experience gives great weight to his opinions, and it is to be hoped that his researches will ultimately place a greater and more efficient telescope in the hands of those dealing with some of the greater questions in astronomy which require the help of more instrumental power than that hitherto employed. The immediate future may therefore witness the dawn of a new astronomy, if combination disks of glass plates, light and easily manipulated, can be utilised. They may carry practical astronomers far beyond the limits reached by means of their previous equipment.

THE CURVE OF SUNSPOT ACTIVITY.—S. Oppenheim, in *Astr. Nach.*, No. 5566, discusses the sunspot activity of the last two centuries and obtains a curve with several periodicities, the longest period being 450 years, and the principal one $11\frac{1}{4}$ years. He conjectures that the long period is identical with that suspected in terrestrial magnetic phenomena, the duration of which is given as between 450 and 500 years. He notes that some variable stars have a second periodicity much longer than the principal one (Mira 218 years, R.V. Tauri 3·6 years). He gives a curve from his formula which is compared with that from Wolf's sunspot numbers. The agreement is close except for the present maximum. His curve gives a sharp maximum at 1928·5, higher than any since 1870; the observations up to the present point to a low flat maximum considerably below that of 1917. The high maximum of 1778 and the low one of 1816 are very well represented.

THE ORBIT OF COMET PELTIER-WILK.—This comet was independently found by Mr. Peltier in the United States and by Mr. Wilk of Cracow. Its definitive orbit has been deduced by Mr. F. Kepinski, also of Cracow. The observations ranged from Nov. 21 to Dec. 30, 1925. They are divided into six groups, which are all well represented by the adopted orbit, the largest deviation being 2″.

The following are the elements:

$$\begin{array}{lll} T & 1925 \text{ Dec. } 7.267395 \text{ U.T.} & \\ \omega & 126^\circ \;\; 7' \;\; 13{\cdot}46'' & \left.\begin{array}{l} \\ \\ \\ \end{array}\right\} 1925{\cdot}0 \\ \Omega & 140 \;\; 34 \;\; 35{\cdot}59 & \\ i & 144 \;\; 36 \;\; 22{\cdot}22 & \\ e & 1{\cdot}0005047 & \\ \log q & 9{\cdot}8828482 & \end{array}$$

This adds another to the considerable list of comets the orbits of which appear to be hyperbolic; the deviation from a parabola in this case is so small that it can reasonably be ascribed to planetary perturbations.

Research Items.

Physiological Cost of Manual Labour.—The subject of Report No. 50 of the Industrial Fatigue Research Board (London: H.M. Stationery Office) is the physiological cost of the muscular movements involved in barrow work, by Dr. G. P. Crowden. Although labour-saving devices have gradually eliminated many heavy manual occupations, yet processes still remain which make heavy muscular demands on the worker. In many industries where continuous transport is involved, loads are usually conveyed by truck or barrow. The movements investigated were those demanded by heavy barrow work of the kind employed in the production of 'Fletton' bricks. A single barrow worker will move approximately 10,000 burnt or finished bricks, or 8000 unburnt or green bricks, in a working day of 9 hours. As a finished brick weighs about 5¾ lb., a worker may transport more than twenty-five tons of bricks through distances varying from 25 to 75 yards in a day. The physiological cost of part of the process was investigated in order to determine: (*a*) the relative importance of the factors involving oxygen consumption on the part of the worker; (*b*) the optimum condition under which such work may be performed. By physiological cost is meant the amount of oxygen used during work and recovery in excess of the amount used during an equal period of time, the subject being in a resting state. The conditions for maximum efficiency on the part of the barrow worker were studied by experiment and observation, and various suggestions made for the improvement of barrow design so as to ensure for the worker the best posture. The appendix gives an interesting account of the application of the recommendations made to routine works' practice, and the report of the works' manager who supervised them.

The Origins of Birds.—It has generally been considered that the fossil bird *Archæopteryx* was the forerunner of modern birds, and that from fully accomplished flying birds the ostriches and their relatives were derived by processes of degeneration. New light has been thrown on the question in an important paper by Dr. P. R. Lowe (*Proc. Zool. Soc.*, p. 185; 1928). The wide distribution of the struthious group in prehistoric times is suggestive of an early origin, and so far from insular restriction indicating potential degeneracy towards flightlessness, through lack of incentive to continued flight, it is probably no more than the expression of the survival of a stock the efficiency of which led to its disappearance elsewhere in the face of more stern competition. A detailed analysis of the distribution and structures of the feathers, and of the skeleton and musculature of the wing and other regions of the body, instead of pointing to degeneration from a flying type, indicates rather a true primitive condition, the wing itself being more closely related to a generalised non-volant sauropsidian fore-limb than to a volant carinate limb. The development of modern struthious birds is arrested at a stage not much more advanced than the downy stage of a fowl. *Archæopteryx*, the *Struthiones*, and the *Tinamous* are regarded as three side issues of the avian stem, which have arisen in the order named, the first being most closely related to the original reptilian ancestry. This arrangement of origins, however, would seem to imply that the perfected feathers of *Archæopteryx* and of modern flying birds had been attained independently, unless it be assumed that modern birds branched at some point from the *Archæopteryx* side-shoot.

A Constant Tetraploid Hybrid.—*Digitalis purpurea* was originally crossed with *D. ambigua* by Gärtner in 1849. In a paper by Mr. B. H. Buxton and the late Mr. W. C. F. Newton (*Jour. of Genetics*, vol. 19, No. 3) the F_1 hybrid is compared with the parents. The leaf-shape of the two parents is very different, and the length-breadth ('phyllic') index of the F_1 is intermediate, the flower characters showing features from both parents. Contrary to earlier counts, the haploid chromosome number is 28. The F_1 hybrid is intermediate and the F_2 is similar but larger, and cytological examination showed that the plants are tetraploid ($2n = 112$). Very few of the F_1 plants produced seeds, the few viable pollen grains occurring as dyads following a division of all the chromosomes after failure to pair and undergo a reduction division. All plants resulting from open-pollination of the F_1 were triploid and sterile. This is an additional case of a new polyploid form arising from a cross and breeding true. The cytological examination makes it clear what has happened and why the hybrid must remain constant and be regarded as homozygous, although of heterozygous ancestry.

Origin of the Rand Gold.—An important investigation of the areal distribution of the pay streaks within the Main Reef group of gold-bearing conglomerates on the Rand has recently been carried out by Leopold Reinecke, and his results and conclusions appear in the *Trans. Geol. Soc. S. Africa*, vol. 30, pp. 89-119; 1928. New criteria bearing on the genesis of the gold and the location of payable ore-bodies in advance of mining operations have been successfully established. It is concluded that the arrangement in plan of the pay-streaks in relation to the folding, fracturing, and dyke-intrusion that has occurred since the banket was formed, definitely disproves the precipitation hypothesis and indicates that subsequent redistribution of the gold has been merely local. The origin of the gold as a stream-deposited placer is proved by the close relation between the highly payable belts and the lines of maximum currents deduced from the lenses of conglomerate. The current lines form a braided pattern spreading out to the east, thus supporting Mellor's deltaic hypothesis in its essential features, but tending to show that the reefs should perhaps be alternatively interpreted as flood-plain deposits laid down at some distance from the sea. The coarseness of the reefs points to very unusual conditions of flooding, and Reinecke considers that the most likely agency for causing the requisite floods would be an ice sheet or glacier which could pick up alluvial gravels in the foothills of a mountain range to the west and deposit a load of coarse debris far down the broad plain of a great valley.

Geophysical Methods of Prospecting.—Prof. A. S. Eve and Dr. D. A. Keys (U.S. Bureau of Mines, Technical Paper 420, 1927) have presented in simple language a general survey of modern geophysical methods of prospecting. Such a survey in the English language has long been overdue, and it is to be hoped that it will assist in some degree to remove much of the scepticism with which geophysical methods are regarded at the present day. By virtue of the very simple treatment afforded, this paper is but an introduction to a rational and fundamental study of the subject, but the authors do not fail to indicate where necessary the difficulties of interpretation, and the need for the employment of experienced geophysicists and geologists in this work. Only the

principal methods are discussed, namely, the magnetic, gravitational, electrical, and seismic methods, while the secondary methods, which have as yet been inadequately tested, are enumerated, and the fundamental distinction between the purely scientific methods and the 'psychological' methods, such as the divining rod, is aptly emphasised. It is to be hoped that the U.S. Bureau of Mines will continue the issue of papers dealing with the different aspects of geophysical prospecting, and thus make available the vast amount of literature now widely scattered in places inaccessible to the average student of the subject.

The Tango (Japan) Earthquake of 1927.—The fourth volume of the *Bulletin of the Earthquake Research Institute* (Tokyo, 1928) contains seven papers on this important earthquake, the strongest felt in Japan since 1923. Of one of the most detailed accounts (pp. 159-177) by Messrs. N. Yamasaki and F. Tada, a summary has already been published (Nature, vol. 120, p. 967). Another account, by Prof. A. Imamura (pp. 179-202), adds several points of interest. In addition to the permanent displacements along the Gomura and Yamada faults, and for about ten miles westwards along the coast, a temporary elevation of about two or three feet seems to have occurred along the coast about 2½ hours before the earthquake. Small sea-waves were also observed at several places, the water being first lowered by about 4 feet and then raised by the same amount above the normal level. General H. Omura (p. 223) illustrates the results of the repeated triangulation of the district. Assuming that a pair of stations to the south were unchanged in position, it would seem that the horizontal dislocation is almost equally distributed on both sides of the Gomura fault. A slight counter-clockwise twist is also to be recognised over the whole seismic area. Precise levellings made in April (H. Omura, p. 225) indicate that the western side of the Gomura fault and the northern side of the Yamada fault were upheaved and the opposite sides lowered by amounts increasing towards the faults. The levellings were repeated after the lapse of forty days, and these show that the changes revealed by the first series were increased in the immediate neighbourhood of the Gomura fault but diminished elsewhere.

Neon Lamps.—According to a recent *Daily Science News Bulletin*, issued by Science Service of Washington, D.C., a new neon lamp has been developed at Schenectady which employs an incandescent cathode in place of the cold cathode of the tubes used at present for illuminated signs. Elimination of the cathode dark space and cathode fall of potential in this way increases enormously the ratio of the light produced to the power supplied, and at the same time reduces the rate at which gas disappears under the influence of the discharge. No details of the design of the tube are given, and it will be particularly interesting to see how the problem of preventing rapid disintegration of the cathode by positive ion bombardment has been solved. The new light has been tested in fog on the Hudson River, and could be picked out from boats more readily than other lights in the vicinity.

Porro Prism Field Glasses.—The first binoculars embodying a Porro prism system were made under the direction of Prof. Ernst Abbe at the Zeiss works at Jena in 1893, and the manufacture of prism binoculars has been carried on continuously by the firm since that date. Developments in recent years have been directed mainly towards obtaining an enlarged field of view and increased light transmission. The various models now being made by Messrs. Carl Zeiss are illustrated and described in catalogue T 380, which has been recently issued by the firm. In addition to the well-known models having object glasses of 24 mm. and 30 mm. respectively, and a magnification of 6 or of 8 and an apparent angular field of view of about 51°, there are wide angle instruments giving a magnification of 8 and a real field of view of 8·75°, or an apparent angular field of 70°. There are also larger binoculars magnifying 10, 12, 16, and 18 times, with high light-transmitting power, for use in sea and air navigation and for other special purposes. Corresponding to the majority of these glasses, monocular models are supplied for use with one eye and, for purposes in which an instrument of small size and weight is required, a miniature monocular (× 8) is included, the outside dimensions of which are 1 in. × 1½ in. × 2½ in.

The Molecular Weight of Hæmocyanin.—Hæmocyanin is a blue pigment which is the respiratory agent in the blood of certain lower animals (*e.g.* Mollusca, Crustacea, and Arachnida). In many ways it is analogous to hæmoglobin, the respiratory pigment in the blood of higher animals, but the metallic constituent of hæmocyanin is copper, while that of hæmoglobin is iron. Different kinds of hæmocyanin appear to exist, since specimens from different species differ in copper content. The *Journal of the American Chemical Society* for May contains an account of an investigation of the molecular weight of hæmocyanin carried out by T. Svedberg and E. Chirnoaga. The material used was prepared from the blood of the vineyard snail *Helix pomatia*, and the isoelectric point was found to be at pH 5·2. Both sedimentation velocity and sedimentation equilibrium methods gave a value of 5,000,000 ± 5 per cent for the molecular weight, while centrifugal experiments at a high speed of rotation indicated that all the molecules of hæmocyanin were of equal weight and practically spherical with a radius of $12{\cdot}1 \times 10^{-7}$ cm. The authors therefore consider this protein to be a chemical individual.

The Preparation of Chloride-free Colloidal Ferric Oxide.—The stability of colloidal ferric oxide is usually explained by assuming that the ferric oxide particle (micelle) consists of x molecules of insoluble Fe_2O_3 and y molecules of a soluble salt, known as the 'solution link.' If the ferric oxide sol is prepared from ferric chloride, some of the latter would act as the 'solution link' and the micelle would have the formula $xFe_2O_3 . yFeCl_3$. The removal of the chlorine by ionisation would account for the positive charge carried by the particle. In view of the widely differing values obtained for the iron—chlorine ratio of such colloidal solutions by numerous investigators, C. H. Sorum has attempted to obtain a constant ratio by carrying the dialysis to the extreme limit of completeness, and his results, which are described in the *Journal of the American Chemical Society* for May, are of considerable interest. It was found that stable ferric oxide hydrosols giving no reaction for chlorine could be prepared from ferric chloride. These sols remained uncoagulated even after dialysis at 90°–97° C. for five weeks, and were not precipitated after twelve months. In view of the fact that the amount of chlorine present was less than 0·0001692 gm. HCl per litre, and that great care was taken to exclude other electrolytes, the 'solution link' theory does not seem to account for their stability.

New Buildings at University College, Nottingham.

As already announced in NATURE, the new buildings of University College, Nottingham, are being opened by their Majesties the King and Queen on July 10. They form a worthy monument to Sir Jesse Boot, by whose generosity they have been provided. They occupy a good position in the new University Park, and provide ample accommodation for a large Arts Department, for four of the main branches of science, and for the Department of Pharmacy; they also include a large assembly hall, a library, a refectory fitted with all modern requirements, and commodious common rooms for men and women students.

CHEMISTRY DEPARTMENT.

The Chemistry Department forms a 'T' shaped building and, with the exception of the basement stores and a room for large scale operations, comprises two floors. In planning it two very important considerations have been kept in mind: first, that the main laboratories should be amply supplied with daylight and means of ventilation; and secondly, that the service store-room should be centrally placed and easily accessible from all parts. In accordance with these requirements four of the main laboratories are lighted both from above and from side windows and their walls are of white glazed tiles; draught is provided for fume chambers and fume hoods on the working benches by means of numerous fans; with these arrangements it would seem that even at busy times the atmosphere of the laboratories will not be unpleasant. The service and supply stores are centrally situated on the main floor, the former opening directly into the largest laboratory and being very conveniently placed for all the other important rooms. The main laboratory will accommodate about 80 students at one time; opening out of it are two smaller rooms, one of which is for physical chemistry. On the same floor there is another large laboratory for inorganic work, a lecture theatre which seats about a hundred, and a class room with accommodation for about forty students; lecture experiments for the theatre and class room will be got ready in an adjoining preparation room. The professor's room and chemistry staff room are also on this floor.

The principal laboratory for organic chemistry, with working places for about thirty students, is on the floor above. Adjoining it are the professor's laboratory and other small laboratories, followed by the Chemistry Museum—for minerals and specimens, and ending with a joint departmental library for physics and chemistry. Each of the three larger laboratories has its own balance room leading out of it.

PHYSICS DEPARTMENT.

The Physics Department is compact, the most frequented rooms being connected by short passages or stairs. The rooms are arranged thus: Workshop on ground floor; lecture rooms, teaching laboratories, and store rooms on the first floor; research laboratories and professor's room and staff room on the second floor. The lecture theatre contains about one hundred seats, the steps of the seating rising from the lecture table on the isacoustic principle. The lecture lanterns are placed in front of the lecture tables and the screen is above the lecturer, so that lantern experiments and slides can be seen by the audience to the greatest advantage. The laboratory teaching is done in four large rooms, of which the largest has a floor space of 72 ft. by 36 ft. Steady tables are obtained by fixing them either on basement walls or on outer walls of the building. The circuit supplies to all laboratories and lecture rooms include direct and alternating high tension current, low tension current by bare copper rods, gas, water, steam, compressed air and exhaust. The research rooms are four in number, the largest having an area of 44 ft. by 28 ft. The workshop floor space, in two rooms, is 54 ft. by 25 ft. In order to protect the rooms above from vibration and noise from the machinery in the workshop, the shafting is carried, not on the ceiling of the workshop, but on a girder frame in the room, attached to the basement floor. The equipment includes four lathes, one of which is a Lorch-Schmidt, milling, shaping, and several drilling machines. A heavy lift connects the three floors of the department.

FIG. 1.—New buildings, University College, Nottingham, from the south-east.

The accommodation in this department should suffice comfortably for, say, 150 undergraduates and future post-graduate research students, as well as for research by members of the staff.

BIOLOGY DEPARTMENT.

The Department of Biology comprises a lecture room accommodating about eighty students and three main laboratories. Of these, the general laboratory, which will be used both by botany and zoology students, contains fifty-four working places, each fitted with a microscope cupboard and a drawer for books and instruments. The advanced laboratory will be used by senior botany students

(including post-graduates) and accommodates thirty workers. The third main laboratory is equipped for bacteriology, its fittings including a large culture-cabinet for the storage of stock cultures. A dark room and photomicrographic equipment is attached to this laboratory. Small research laboratories are provided for the head of the Department and members of the staff.

In addition to the laboratories there is a teaching museum, the long window case of which is convertible into a working bench. Senior zoology students will work here, and provision has also been made for the storage and study of medicinal plants and specimens. A plot of land has been set aside for experimental field studies and plant houses in the grounds behind the department.

DEPARTMENT OF GEOLOGY AND GEOGRAPHY.

The Department of Geology and Geography occupies the ground floor in the back western wing of the new buildings. It is compactly arranged and is self-contained with an entrance of its own. Two large elementary laboratories are provided for geology and geography respectively. A third spacious laboratory is set aside for the combined use by advanced students in both subjects. In each of these rooms there will be the usual work benches and tracing tables, together with adequate drawer accommodation for those geological collections which are in most frequent use and for maps of all kinds. There will also be glass-fronted wall cases for the exhibition of teaching series. The museum will be similarly equipped for the preservation and demonstration of more valuable exhibits. A room with seating accommodation for nearly forty students has been set aside for lecture purposes, whilst a suite of smaller rooms is being furnished for such purposes as staff research laboratories, classroom, preparation room, dark-room, and store room. A wide corridor, which connects all these rooms, will be fitted with additional show cases, and with cupboards for the storage of wall maps.

PHARMACY DEPARTMENT.

The Pharmacy Department consists of a large dispensary, a class room, and a model manufacturing laboratory, and shares with the Biology Department a laboratory-museum for pharmacognosy. The manufacturing laboratory is fitted with steam-heated copper pans, vacuum and fractionating stills, ovens, etc., and electrically-driven drug grinding machinery. An enclosed portion of this laboratory is devoted to apparatus used in testing, such as a polarimeter, refractometer, microscopes, and balances.

The Aurora and its Spectrum.[1]

THE two outstanding features that characterise the spectrum of the polar aurora are a set of four well-marked bands belonging to the first negative group of nitrogen, and a strongly defined very narrow spectral line in the green, the wave-length of which, measured by Babcock with a Fabry and Perot interferometer, was found to be $5577 \cdot 35 \pm 0 \cdot 005$ A. Less important features are a set of bands belonging to the second positive group of nitrogen and a miscellaneous, and as yet unidentified, set of sixteen lines or narrow bands. The auroral green line, the identity of which was for long unknown, was shown in 1925 by McLennan and Shrum to originate in gaseous atomic oxygen. This spectral line exhibits great variations in intensity with changing conditions of excitation. Helium and neon when mixed in excess with oxygen enhance the intensity of the line. Argon does the same thing, but to a much greater extent. In 1927, McLennan and McLeod established the identity of the oxygen green line with the auroral green line beyond question, through obtaining $5577 \cdot 341$ A. $\pm$ $0 \cdot 004$ A. for the wave-length of the former by the use of a Fabry and Perot interferometer.

The region in which auroræ generally occur in the upper atmosphere has for its lower boundary a height of approximately 80 km., and for its upper limit a height of more than 400 km. Auroræ occur with greatest frequency and brilliance at a height of 98 km., but they have been observed so high as 1000 km. It follows, then, that oxygen and nitrogen must be constituents of the earth's atmosphere up to these great heights. Through the work of Campbell, Lord Rayleigh, Slipher, and others, it is now known that on any clear night in any latitude, the whole sky is glowing with a faint green light, which is monochromatic and has the same wave-length as the 'green line' of the polar aurora. While the polar aurora appears to be excited by streams of electrons emitted by the sun from time to time, the green light of the non-polar aurora appears to originate through the action of some other agent.

The presence of the first negative bands of nitrogen in the spectrum of the aurora connotes an 'excitation potential' of $19 \cdot 6$ volts, while the absence of any nitrogen bands in the spectrum of the non-polar aurora imposes an upper limit of $12 \cdot 6$ volts for the 'excitation potential' of the oxygen-auroral green line. With such 'excitation potentials' applied to oxygen, the only wave-lengths, with two doubtful exceptions, other than $\lambda 5577 \cdot 341$, known to originate in atomic oxygen, that could be emitted, lie too far in the ultra-violet or in the infra-red to appear in spectrograms taken hitherto of the auroral light.

The theoretical spectral term scheme formulated for atomic oxygen provides for two low metastable states, namely, ${}^1S_0$ and ${}^1D_2$, in addition to the normal ${}^3P_{012}$ levels. The recent work by Bowen on spectra of nebulæ makes it clear that so-called 'metastable states' are but states of long mean life, and that provided the gases involved are at a sufficiently low density, one may expect emission of radiation, corresponding to transitions between levels ordinarily designated as metastable. In such transitions it will be noted that the electronic azimuthal quantum-number selection rules must necessarily be violated.

Under similar density conditions it is clear, from Bowen's work, that transitions are to be expected in which the inner quantum number selection rules also may be violated. In an investigation recently carried out by McLennan, McLeod, and Ruedy, photographs were obtained with a powerful echelon spectrograph of the magnetically resolved components of the auroral green line. The structure was shown to be that of a normal Zeeman triplet, and this result, combined with other evidence available, goes to show that the transition ${}^1S_0 \longrightarrow {}^1D_2$ is the one that gives rise to the auroral green line.

In an attempt to learn something of the agent responsible for the emission of the auroral green light from clear night sky, several series of observations were recently made by McLennan, McLeod, and Ireton, on the intensity of light received from the zenith in the course of a single night. In this investigation two lines of procedure were followed. In the one case several spectrographs of high light power were constructed and used to photograph the green line at

[1] Abstract of the Bakerian Lecture delivered by Prof. J. C. McLennan, F.R.S., before the Royal Society on June 28.

intervals throughout the night; in the other case, a continuous record of the intensity was obtained by means of a filter and slit moving over a photographic plate. With the most efficient of the spectrographs used, it was found possible to obtain satisfactory spectrograms of the green-line radiation from the night sky with exposures so short as 30 minutes.

By co-ordinating all the results obtained during a period that included observations on nine consecutive nights, it appears that from sunset onwards there is a gradual increase in the intensity of the auroral light from clear night sky. The intensity reaches a maximum at about an hour after midnight, and from that time onwards until sunrise it gradually lessens.

Haddock Biology.

IN *Fisheries, Scotland, Sci. Invest.*, 1927, III. (January 1928), Dr. Harold Thompson continues his account of recent investigations into the economy of the haddock fisheries. In this paper he deals particularly with the haddock of the north-western North Sea, including the Moray Firth, the bight on the east Scottish coast (Buchanness-Fife Ness) and the Firth of Forth.

Two matters are of special interest. For the first time on record, living haddock marked and released were recaptured. The haddock is a delicate fish to handle, and efficient implements of capture, such as the trawl, damage the fish beyond hope of recovery. Thus it is necessary to employ the tedious method of hand-lining for securing the specimens to be marked. A total of 1112 fishes were marked and released at different times during the years 1923–27. Of these, only 57 were recaptured, mostly within three months from liberation. It is thus seen that large numbers of haddock would require to be marked to secure a fair number of returns, especially of fish absent more than three months.

In his extremely interesting study of the fluctuations in the annual recruitment of haddock stock by new brood, Dr. Thompson demonstrates that there are great differences in the number of surviving brood haddock during a series of years. In the extreme case in the North Sea, the numbers contributed in a specially good survival year may be twenty-five times more than those of an unusually poor year. Natural variations of this order, occurring at source, place the question of 'fishing out' or 'overfishing' in a new light.

The experience of recent years has been that, provided that a cycle of good to moderate brood years is experienced, the severe pruning effect of the fisheries is more than counterbalanced. On the other hand, a succession of poor to moderate years inevitably leads to an outcry on account of the scarcity of haddock, and at such times attacks are made on the present-day methods and intensity of fishing. Since the War there has been in the North Sea an example of both a poor and a good cycle of brood years. Thus, the years 1921 and 1922 produced a pair of broods almost negligible in numbers, and the years 1923 to 1926 good, or at least moderate, broods. In 1922, 1923, and the first part of 1924 the haddock catches in the North Sea dwindled away to an unprofitable point, but from the latter part of 1924, when the splendid 1923 brood had reached a marketable size, the average catch per unit of time kept mounting up until the winter of 1926. Since then, however, the average catches in the North Sea generally have tended steadily to fall to a more regular level, but to increase in the area north-west of Scotland. The main cause of this fluctuation was the gradual elimination of the prolific and widely distributed 1923 brood, together with its normal movement towards the north and west, which are the localities where the haddock makes its chief home in later life. The broods of the succeeding years 1924 to 1926 were not capable of maintaining the increased average catches occasioned by the 1923 brood.

The Public Library System of the United States.

IN the year 1926, with the assistance of the Carnegie United Kingdom Trustees, a visit was paid to the jubilee conference of the American Library Association by a representative body of British librarians. The observations of six of these were published by the trustees last year under the title "Some Impressions of the Public Library System of the United States of America." The value of this report induced the trustees to invite two other British librarians, Miss K. E. Overbury and Dr. E. E. Lowe, to attend last year's annual conference of the American Library Association, held in Toronto.

As the American public library system is probably more developed than that of any other country of the world, this account of a pilgrimage among American libraries cannot fail to be of interest to librarians in England. The publication is confined to aspects of the subject which were not treated at length in the earlier report.

In the United States, the public libraries are definitely considered as part of the educational machinery of the country. It is evident that a rapidly growing nation, with a large immigrant population of all nationalities, must use every means of educating its new citizens rapidly. The public library service is a ready and efficient means of accomplishing this object. Consequently, work with the schools and children is probably more developed in the United States than elsewhere; although, of course, this may be due in part to the preponderance of women librarians, and their natural regard for children. Collections of books for children are sent to schools by a large majority of the libraries. In many libraries there is a well-appointed children's room with a specially trained librarian. Children come to the library room in groups for a library hour under supervision. Stories are told and book-talks given. This story-hour has been the cause of considerable discussion, and librarians have been divided in opinion as to the value of the service. It continues, however, to be developed.

A particular feature of the progressive libraries in America is the number of the staff, which is very much greater than is provided in Great Britain. Excellent provision is made for their accommodation and comfort; one library has a luxurious lavatory with five baths and hot-air blasts for drying, instead of towels.

Another speciality are the numerous well-organised travelling libraries, like those of Samuel Brown in Scotland from 1817 to 1836. Book vans in the States serve isolated communities, which are too small to have a branch or deposit station. The vans have 'stops' in various sparsely populated districts and also visit houses. A valuable feature is the social side of the work. Miss Overbury recounts a humorous occasion when the librarian, who had left books on poultry for the farmer's wife, inquired after the chickens and whether the books had been useful; the farmer replied favourably, adding, "My wife reads the books and I look after the poultry."

S. C. B.

University and Educational Intelligence.

CAMBRIDGE.—Dr. H. S. Carslaw has been elected to a supernumerary fellowship and Dr. E. C. Stoner to a research fellowship at Emmanuel College. Dr. H. Godwin has been re-elected to a research fellowship at Clare College. Dr. P. I. Dee has been elected to a Taylor research fellowship at Sidney Sussex College. Mr. G. F. C. Gordon, Trinity College, and Mr. L. G. P. Thring, Trinity College, have been reappointed as superintendents of the engineering workshops and drawing office respectively.

J. D. Solomon, Trinity College, has been awarded the Harkness scholarship in geology, and K. M. N. Paterson, Newnham College, has been awarded the Wiltshire Prize in geology. The Frank Smart prizes in botany and zoology have been awarded to S. Clay, Emmanuel College, and J. B. Harman, St. John's College, respectively.

DURHAM.—The following appointments have been made in the Durham division of the University of Durham: Mr. J. A. Chalmers has been appointed lecturer in physics in succession to Dr. R. K. Schofield, who is joining the staff of the Rothamsted Experimental Station. Mr. Chalmers went from Highgate School with a Foundation Scholarship to Queens' College, Cambridge, where he obtained first class honours in physics in Part 2 of the Natural Sciences Tripos in 1926. He has since been a demonstrator in the Cavendish Laboratory. Miss E. Marion Higgins has been chosen to fill a lectureship in botany which was vacated by Dr. Elsie Phillips on her marriage. Miss Higgins is a graduate with first class honours in botany of the Royal Holloway College, London, and has for two years been a demonstrator and research student in the University of Liverpool. She has published papers dealing with marine algology.

A NEW Department of Geography has been created in the Faculties of Arts and Science. Mr. Gordon Manley, who has been made lecturer in geography, graduated from Caius College, Cambridge, with first class honours, and with distinction in climatology in Part 2 of the Geographical Tripos. At Cambridge he worked on geodetical problems under Sir G. Lenox-Conyngham. He was a member of the Cambridge Arctic Expedition to Greenland in 1926, and conducted pendulum observations there. Since 1926 he has been assistant lecturer in geography at the University of Birmingham.

EDINBURGH.—At the graduation ceremonial on Thursday, June 28, the Honorary Degree of Doctor of Laws was conferred on, among others, Sir John Rose Bradford, president of the Royal College of Physicians, London; Prof. F. G. Donnan, professor of general chemistry in the University of London; Prof. J. Cossar Ewart, professor-emeritus of natural history in the University of Edinburgh; Dr. R. A. Fleming, president of the Royal College of Physicians, Edinburgh; Dr. G. L. Gulland, professor-emeritus of medicine in the University of Edinburgh; Mr. J. A. Hood, founder of the James A. Hood chair of mining in the University of Edinburgh; Mr. H. S. Wellcome, founder of the Wellcome Research Laboratories at Gordon College, Khartoum, and of the Wellcome Bureau of Scientific Research, and the Historical Medical Museum, London; Prof. Niels Bohr, professor of theoretical physics at the University of Copenhagen.

The Degree of Doctor of Science was conferred on Mr. E. T. Copson, for a thesis entitled "(*a*) Some Problems in the Theory of the Partial Differential Equations of Mathematical Physics; (*b*) Some Applications of Holder's Inequality"; Mr. J. W. Donaldson, for a thesis entitled "The Heat Treatment, Volume Changes, and Thermal Conductivities of Grey Cast Iron between 15° and 600° C."; Dr. J. A. Hawkins, for a thesis entitled "A Gasometric Method for Determination of Reducing Sugars, and its Application to Analysis of Blood and Urine"; Mr. A. R. Urquhart, for a thesis entitled "The Adsorption of Water by Cotton."

OXFORD.—At the Encænia on June 27, the degree of D.Sc. was conferred on Lord Melchett of Landford. In his Latin speech introducing Lord Melchett, the Public Orator alluded to his advocacy, both theoretical and practical, of scientific research in its bearing on useful ends.

In a Convocation held on June 29, Viscount Grey of Fallodon was admitted and installed as Chancellor of the University, in succession to the late Viscount Cave. The speech of the Public Orator, in welcoming the new Chancellor, contained an apt reference to his skill in ornithology, and, with a glance at his literary and piscatorial pursuits, a classical play on the words "musæ" and "muscæ."

ST. ANDREWS.—In accepting the resignation of Prof. J. A. C. Kynoch from the chair of midwifery in the University, on his having reached the age limit as one of the visiting medical officers of the Dundee Royal Infirmary, the University Court records its high appreciation of the services rendered by him as the occupant of the chair for a period of thirty years, and as Dean of the Faculty of Medicine from 1909 until 1920.

Dr. George Forbes has presented to the University the books forming the library of his father, the late James David Forbes, for twenty-seven years professor of natural philosophy in the University of Edinburgh, and for nine years, until his death in 1868, Principal of the United College of St. Salvator and St. Leonard in the University of St. Andrews.

The degree of D.Sc. has been conferred upon the following: N. M. S. Langlands, for a thesis on experiments on binocular vision; W. Saddler, for a thesis on form theory with its associated geometry; R. F. Thomson, for a thesis on dyestuffs and optically active bases.

MR. F. W. ANDERSON, a graduate of Leeds, has been appointed assistant lecturer in zoology and geology at University College, Southampton.

OF the summer vacation courses for teachers in England, those arranged by the Education Committee of the West Riding of Yorkshire, to be held at Bingley on Aug. 1-15, are noteworthy for the wide range of choice of subjects offered. The programme comprises eleven courses in all, including one, conducted by Dr. H. W. T. Wager, on "The Teaching of Nature Study," intended to give guidance in the teaching of natural history in schools. Biological theory will be dealt with and the relation of biology to instruction in health will be discussed. The time-table is so arranged that students following this or any other of the special courses will be able to attend also a general course on matters of current interest in education, including, "The Library and the School," "The Modern or Central School," "Vocational Guidance," "School Journeys," "The Doctor and the Teacher," and "Drama and the School." Simultaneously, courses in physical training and swimming will be given in the neighbouring town of Ilkley.

Calendar of Customs and Festivals.

July 5.

ST. MODWEN, also known by many other names, such as Monynna, Moninia, Moduenna, Nodwenna: a saint probably of the ninth century. Of royal Irish birth, she is said to have ministered in Ireland, England, where she is associated particularly with Burton-on-Trent and the island of Andresey (otherwise the Isle of St. Andrew, to whom a shrine there was dedicated), and Scotland, especially at Stirling and Galloway, where she built three churches. She is also reputed to have made three pilgrimages to Rome, one when well over the age of one hundred years. The multiplicity of her names, and the peculiarities of the records of her missionary journeys and pilgrimages, have led to the suggestion that three saints, one for Ireland, one for Scotland, and one for England, have been confused. Her connexion with Saint Brigit and with a retinue of nuns who accompanied her wherever she went, suggests that, like that saint, her legend has grown by accretions reminiscent of a pagan deity, and that the cult of this goddess was localised at many places in the three countries, or that the acts of the saint incorporate three separate deities in a synthetic personality. She is sometimes identified with St. Etain, Edania, Etavin, or Heidin, of Tumba, Co. Roscommon, also venerated on this day. The grave of the latter lay near the ruins of her church, while near a church called Killoscoban was a well sacred to her, to which many resorted for spiritual comfort and the healing of disease.

July 7.

OUR LADY OF CHARTRES.—On this day is observed a festival in honour of the Virgin Mary at Chartres, the oldest and most important shrine of the Virgin in France. This is generally held to have been originally a pagan cult of the Gauls. A primitive wooden image of the deity and child, which was later identified with Our Lady, was an object of great veneration in the Cathedral until it was burned during the French Revolution. Another relic, however, still remains, the Veil of the Virgin, presented to the Cathedral by Charles the Bald in 876. It had been given to Charlemagne by the Empress Irene. The Veil is exposed at rare intervals only, the last occasion being in 1927, when the tenth centenary of the building of the crypt by Bishop Fulbert was celebrated. The last occasion previously was 1876, on the one thousandth anniversary of the gift of the relic.

July 9.

At Wolverhampton on this day, the eve of the great fair, which in the time when the wool trade flourished, was a great resort of wool merchants, a procession took place in which men in antique costume, musicians, peace officers, and many of the prominent inhabitants took part. The fair lasted eight days by the charter, but seems to have been prolonged to fourteen. It was finally discontinued by the Lord of the Manor. It is an interesting example of a local celebration which had, through commerce, grown to national or, owing to the relations of the wool trade with Flanders, even to international importance. Antiquarians have at different times suggested various explanations of the procession, some connecting it with the necessity of a town guard to keep order, which would make it an analogue of the setting of the watch in London and elsewhere; others have regarded it as a survival of the Corpus Christi celebration.

July 10.

ST. ETTO (seventh century).—An Irish missionary saint, known in French as Zé. He passed over to France and made pilgrimage to Rome, finally settling in the diocese of Cambrai. He is held in great veneration by the peasantry, and at Liesses a great festival with processions is held annually in his honour on July 10. Near Dompierre there is a fountain of Zé. Among the peasants he is invoked for the cure of diseases and the prolongation of life, as well as to avert distempers from the cattle and other animals.

July 13.

ST. ERNON OR ARNEY of Enniskeen, partly in Co. Louth and partly in Co. Cavan, where his festival was celebrated on this day and stations performed at a holy well now dried up. There was also a large block of stone outside the church, on which, significantly, the Holy Mass used to be celebrated at times of persecution.

July 15.

ST. SWITHIN'S DAY, actually falling, according to calendrical reckoning, on July 2, is usually regarded as the fifteenth day of the month. Some parish accounts, which record expenditure by the churchwardens, indicate that on this day a form of celebration must have taken place, although no other record appears. According to widespread popular belief, rain on this day will be followed by rain for forty days. Reference to this belief as current among husbandmen is made by Ben Jonson in "Every Man in his Humour" and there are numerous other references in literature which show that it is a popular belief of long standing.

The traditional origin of the superstition is that St. Swithin, bishop of Winchester, who died in 865, was buried in the open churchyard at his own request. Many miracles were wrought at his tomb, and the monks, therefore, on his canonisation wished to honour him by moving his body to the choir of the church. The removal was to have taken place in a solemn procession on July 15, but it rained so violently on this and the succeeding forty days that the removal was abandoned, and instead a chapel was erected over the grave. The fact is, however, that the site of his grave was forgotten until the tenth century and his relics were translated to the Cathedral church in 971, and in 1093 removed to the present church, founded in 1079.

On several occasions in the year forecasts of the weather are based on its character on a particular day or a particular season. Some are traditional experience, such as the prognostication of the weather in the coming year from the direction of the wind on New Year's Eve, or the belief that a mild clear New Year's Day foretells hard weather up to May. In the Highlands of Scotland a fine Shrovetide is said to bring a foul Easter. On the other hand, some such prophecies suggest a magical or religious basis. The belief in the power of spirits in the twelve days preceding Epiphany, which in a more refined form becomes a conception of their peculiar sanctity, underlies the idea that each of these days foretells the weather in one month of the year. Other saints' days and festivals are associated with forecasts of weather, and usually for the period of forty days following, for example, the duration of the classical Halcyon Days, when the kingfisher sat on its nest, St. Vincent, Jan. 24; St. Paul, Jan. 25; Candlemas or the Purification of the Virgin; St. Processus and St. Martinian, July 2; St. Martin, July 4; as well as St. Swithun. The German custom of casting the image of the saint into a river, recorded on St. Paul's day (see under Jan. 25, NATURE, Jan. 21, p. 121), suggests that this association probably arose from some rain-bringing ceremony or invocation similar to those which take place at the tombs of Moslem saints (Westermarck, "Ritual and Belief in Morocco," pp. 244 sqq.).

Societies and Academies.

LONDON.

Royal Society,[1] June 21.—**E. S. Semmens**: The selective photo-chemical action of polarised light (Part 3). Well-washed potato starch grains, in distilled water, disintegrate under the influence of a Tyndall beam of light, polarised by the colloidal particles of diastase, contained in an outer vessel. The stages of hydrolysis bear a strong resemblance to those formed under ordinary diastatic action, suggesting that the polarisation of the incident radiation of heat or light is an important factor in the action of colloidal catalysts. As catalytic action takes place at surfaces, the possibility of some correlation between the constant plane of vibration of the radiation and the definitely orientated force fields or electron orbits of the molecular surface layers is indicated.

W. R. Brode and **R. A. Morton**: The absorption spectra of solutions of cobalt chloride, cobalt bromide, and cobalt iodide in concentrated hydrochloric, hydrobromic, and hydriodic acids. The principal absorption band of cobalt chloride in concentrated hydrochloric acid was shown previously to consist of six superimposed component bands. The frequencies of the maxima of these bands, and also of bands in the blue and green regions, are always, within the limits of error, integral multiples of 12·28 *f*. Cobalt bromide in concentrated hydrobromic acid gives similar bands. Corresponding bands of the chloride and bromide systems are given by the use of the same integers, but with fundamental frequencies of 12·28 and 11·70 respectively. Cobalt iodide in hydriodic acid also shows banded absorption, the frequencies of maximum absorption being integral multiples of a fundamental frequency of 10·79 *f*.

T. M. Lowry and **G. G. Owen**: The mechanism of chemical change. (1) Promotion and arrest of the mutarotation of tetra-acetylglucose in ethyl acetate. Solutions of tetra-acetylglucose in dry ethyl acetate have been prepared which were sufficiently pure to show no change of rotatory power during a period of several hours. The addition of a drop of water does not initiate mutarotation, but a rapid change is induced when a drop of dilute acid or alkali is added; the mutarotation curves are, however, inflected instead of unimolecular, as if the action had been resolved into two consecutive stages. Since the action of alkali was the same when the polarimeter tube was rinsed with the solvent and refilled with a second sample of the clean dry solution, it appears possible that these inflected mutarotation curves are characteristic of surface action, whereas the normal unimolecular curves are developed by homogeneous catalysis.

C. H. Gibson and **C. N. Hinshelwood**: The homogeneous reaction between hydrogen and oxygen. The combination of hydrogen and oxygen at temperatures between 500° and 600° C. has been studied by a static method. Above 500° a homogeneous reaction comes into play. The reaction is markedly accelerated by steam, but also by gases such as helium, nitrogen, and argon. The results can be interpreted by assuming reaction chains propagated through the gas. These chains are broken by de-activation of molecules in a heterogeneous reaction at the walls of the vessel, and lengthened by inert gases, which increase the time during which molecules escape contact with walls. The order of effectiveness of various inert gases can be correlated with diffusion coefficients.

H. Glauert: The characteristics of a Karman vortex street in a channel of finite breadth. The theory of the drag due to the formation of a vortex street behind a body has been developed by Karman, and is now extended to the case where the breadth of the vortex street is not more than one-sixth of the breadth of the channel. The formula obtained for the drag of the body is similar to that given by Karman and involves two parameters which must be determined experimentally. By means of certain assumptions it is possible to predict the constraint of the channel walls in terms of the flow in an unlimited fluid. These assumptions are valid for bodies of bluff form only.

K. R. Rao and **A. L. Narayan**: On series in the spark spectra of germanium. To aid in the identification of the important groups of different stages of ionisation, the spark spectrum of the element under different conditions of excitation has been photographed from λ6500 to λ2080, and measured with an accuracy of about 0·05 A. About eighty lines of germanium have been analysed. The spectrum of Ge II has been almost completely analysed. In the spectrum of Ge III, series of sharp and diffuse triplets have been detected, converging to a common limit. Series in the spectrum of Ge IV have been extended to the region of long wave-lengths, members of the secondary series being found.

N. K. Adam: The structure of thin films (Part 11). With the object of measuring the cross-section of the benzene ring, in the plane of the ring, the behaviour of various derivatives of resorcinol and phloroglucinol, with long chains in the ring, has been studied in the monomolecular surface films. The main object has not been attained, since no substances could be found which formed films in which the benzene ring was both lying flat on the water and packed closely against the rings of neighbouring molecules in a similar position. The hydroxyl groups in the ring seem to increase the attraction of one ring packed face to face on another, and this increase is more important for orientation than the increase in the attraction for the water, caused by the hydroxyl groups. In the case of compounds with a resorcinol group at each end of a long chain, which form gaseous films, cohesional corrections to the gas laws are diminished by acetylating the hydroxyl groups, and the area of the molecule is increased, confirming the view that the molecules lie flat in the gaseous films.

E. Newbery: Metal overvoltage measurements with the cathode ray oscillograph. Experiments on metal deposition with the aid of the cathode ray oscillograph show that overvoltage and transfer resistance do not occur unless a gas is being liberated at the electrode. Hydrogen is always deposited along with metal when the metals of the iron group are separated electrolytically from pure solutions of their respective salts, and this gives rise to hydrogen overvoltage at the cathode. This exceptional behaviour is probably due to hydration of the ions of these metals.

G. B. Bandopadhyaya: Photoelectric effect of soft X-rays. The number of photoelectrons liberated from twelve different elements under soft X-rays from a copper target has been measured with a special quartz tube. The relative photoelectric sensitiveness is of same order as observed under ultra-violet light. From the critical potentials it is inferred that under soft X-rays by far the greater number of photoelectrons come from the valency orbit, or from orbits very close to it, and have energies below 10 volts.

A. Caress and **E. K. Rideal**: On the chemical reactions of carbon monoxide and hydrogen after collision with electrons. The decomposition of carbon monoxide into carbon and carbon dioxide (also some suboxide), and its union with hydrogen to form

[1] Continued from Vol. 121, p. 1042.

dehyde (and polymers) under excitation by ...n impact have been examined. Hydrogen atoms produced by thermal dissociation react directly with carbon monoxide molecules, and also react with enhanced efficiency with carbon monoxide positive ions. This increase in reactivity is attributed to either a chain or a cluster mechanism. Hydrogen molecules react with carbon monoxide positive ions, but more readily with ions excited to the 2 ^{3}S level: the reaction products have been obtained in quantities sufficient for chemical tests.

F. P. Bowden and E. K. Rideal: The electromotive behaviour of thin films. (Part 1) Hydrogen. A quantitative investigation of the changes of electrode potential at the surfaces of metallic cathodes during the electrolytic deposition and removal of very small quantities of hydrogen show that the electrode potential is a linear function of the surface concentration of the hydrogen, and the potential of the polarised cathode depends only on the true surface concentration of the added hydrogen, and is independent of the nature of the underlying metal. Apparent differences observed are due to differences in real areas of cathodes. The amount of hydrogen deposited is small, sufficient to form 1/3000th of an atomic layer, causing a change of 100 millivolts in electrode potential. The results can be explained on the assumption that electrode potential is due to electric doublets on its surface, the electric moment of these doublets being that of a proton and electron separated by a distance equal to the diameter of the hydrogen atom. (Part 2) The areas of catalytically active surfaces. The real area of cathode surfaces has been evaluated by measurement of amount of deposited hydrogen required to raise the potential by a definite increment. The real area of metal sponge, such as platinum black, may easily attain a value two thousand times its apparent area. The real area of a sand-papered metal is about ten times its apparent area, and nickel activation by alternate oxidation and reduction causes an increase of nearly fivefold. Rolling reduces real area. Specific catalytic activity of various metals differs widely, but for any one metal specific activity of the surfaces only suffers small variations by chemical or thermal treatment. Violent mechanical treatment, such as sand papering or rolling, causes marked increase in activity.

W. Payman: The detonation wave in gaseous mixtures and the pre-detonation period. An experimental method has been developed for photographing the invisible shock or compression waves sent out through a gas mixture on detonation of a solid or gaseous explosive in contact with it. The effect of position of point of ignition on initial movement of the flame in a closed tube has been examined; the observed retardation of the flame seems to occur simultaneously with the break-up of flame front into two separate portions moving in opposite directions. Visible evidence has been obtained of the movements of the hitherto invisible compression waves. These are not due to the spark, as has been previously supposed, the spark-wave being comparatively feeble. The compression waves travel at speeds much greater than that of sound in the gaseous medium through which they are passing, and appear to be due to renewed chemical activity of some kind behind the flame front. Similarly, the detonation wave appears to have its origin behind the flame front.

G. P. Thomson: Experiments on the diffraction of cathode rays. (2) Further experiments on the diffraction of cathode rays by films of aluminium, gold, and platinum show very close agreement with the de Broglie wave theory. Deflection in a magnetic field shows that the diffracted rays have the same velocity as the undeflected rays within 1 per cent. A large number of diffraction rings can be seen when a magnetic field is used, which is analogous in its action to the achromatising effect of a prism on Newton's rings. The rings are all of the sizes predicted by the wave theory from the crystal structure. From the observed resolving power the minimum number of waves in a train is about 50 for the beam of cathode rays used.

R. Ironside: The diffraction of cathode rays by thin films of copper, silver, and tin. The patterns are like those got in X-ray powder analysis, consisting of a series of concentric rings, with modifications. These patterns may be interpreted on the de Broglie hypothesis by considering an electron as a group of waves, and only by this theory has an explanation of the phenomena been derived. There is a discrepancy of 1 per cent between the cathode ray and X-ray methods of determining the crystal spacing. According to theory, the product of the diameter of a given ring in the pattern due to a given metal and the square root of the voltage used in producing it should be constant (except for ½ per cent relativity correction for each 10,000 volts); the data derived from the experiments satisfy this test.

A. Reid: The diffraction of cathode rays by thin celluloid films. A probable structure for the films is derived; the experimental results agree with those predicted by the de Broglie theory.

W. E. Curtis and W. Jevons: The Zeeman effect in the band spectrum of helium. The Zeeman effects in two regions of the helium band spectrum have been investigated in fields up to 20,000 gauss with an 8-ft. concave grating (third order) and a Fabry-Perot 1-cm. étalon. Resolution of the magnetic components has only been effected in one case, but a great many instances of broadening have been observed; some information as to the polarisation of the components has been obtained by means of a double-image prism. In the case of those bands which are due to transitions between S and P electronic states, the results are completely in accordance with theoretical predictions. In the case of another band, details of which have not been previously published, the effects are relatively large throughout both Q and R branches (the P branch being too weak to observe) and they show similar polarisations. The final state of this band is known to be the 2P electronic state of the ortho-He_2 molecule, but the relation of the initial electronic state to the known term sequences of He_2 is not clear.

B. F. J. Schonland: The scattering of cathode rays. The author's recent cathode-ray scattering experiments are not suitable as an adequate test of the relativity correction to the orbit of a β-particle deflected by an atomic nucleus, owing to the effect of radiation and of the spiral form the orbit may take. An estimate is made of the amount of scattering to be expected, which is in fair agreement with that observed.

VIENNA.

Academy of Sciences, Feb. 2.—**A. Müller**: A convenient preparation of 1, 4-dioxy-*n*-butane (tetramethylene-glycol) and 1, 4-dibrom-*n*-butane.—**E. Rona and E. A. W. Schmidt**: A method of producing highly concentrated polonium preparations. Distillation of a gaseous polonium compound in the presence of a collecting metal.—**E. Bussecker**: Volatility curves of radium-C and -B deposited on gold by single and double recoil. A possible alloy between the active deposit and the gold leaf substratum.—**H. P. Cornelius and M. Furlani-Cornelius**: Report on

geological investigations on the Insubric line between the Tessino and the Tonale pass.

Feb. 9.—E. Gebauer-Fülnegg and E. Riess: The course of oxidation in aryl-sulpho-arylides.—E. Gebauer-Fülnegg, E. Riess, and S. Ilse: Studies on aryl-sulpho-chloride (2).—S. Oppenheim: The periods of sunspots: Besides the 11-year period there seem to be many others including a longer period of some 450 years comparable with the earth's magnetic period. As a variable star the sun may be compared to Mira Ceti and R. V. Tauri.—O. Abel: A contribution to the phylogenesis of horses: the phylogenetic position of *Hipparion* and *Neohipparion*. *Hipparion* is confirmed as a form between the Miocene and Quaternary horses; *Pliohippus* and *Plesippus* are apparently not direct ancestors of recent horses.—R. Girtler: The calculation of indeterminate kinetic-static systems.—R. Pöch (the late) Anthropological publications, vol. I. West African negroes were studied in prisoner-of-war camps.

Official Publications Received.

BRITISH.

Catalogue of Indian Insects. Part 14: Palpicornia. By A. d'Orchymont. Pp. iv+146. 2.8 rupees; 4*s.* 6*d.* Part 16: Cosmopterygidae. By T. Bainbridge Fletcher. Pp. v+83. 10 annas; 1*s.* Part 17: Yponomentidae. By T. Bainbridge Fletcher. Pp. iv+26. 8 annas; 10*d.* (Calcutta: Government of India Central Publication Branch.)

Hampstead Garden Suburb. Programme of the Coming-of-Age Celebrations, June 23rd to 30th, 1928. Edited by W. Loftus Hare. Pp. 66. (London: F. Howard Doulton and Co., Ltd.) 6*d.*

FOREIGN.

Ministry of Public Works, Egypt: Physical Department. Helwan Observatory Bulletin No. 38: Time Determinations and Observations of Wireless Time Signals, 1926, October and November. By P. A. Curry. Pp. 20. (Cairo: Government Publications Office.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 5: An Ornithological Survey of the Serra Do Itatiaya, Brazil. By Ernest G. Holt. Pp. 251-326+plates 6-19. (New York City.)

CATALOGUES.

McGraw-Hill Books on Mathematics and Physics. (List 18.) Pp. 16. (London: McGraw-Hill Publishing Co., Ltd.)

A Catalogue of Important and Rare Books on Zoology and Geology: including the Entomological Library of G. T. Bethune-Baker and a Selection from the Library of W. de Selys Longchamps. (No. 417.) Pp. 130. (London: Bernard Quaritch, Ltd.)

Addenda List for General and Industrial Laboratory Apparatus Catalogue. Eighth edition. Pp. 40. (London: A. Gallenkamp and Co., Ltd.)

Catalogue of Microscopes. Part 5: Photomicrographic and Projection Instruments. Pp. 501-532. 32nd edition. Part 6: Petrological Microscopes. 32nd edition. Pp. 601-624. (London: W. Watson and Sons, Ltd.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 7.) Pp. 62. (Paris: Librairie Adrien-Maisonneuve.)

Old and Modern Books: Bibliography, English and Foreign Literature, Voyages and Travels. (No. 21.) Pp. 66. (Newcastle-on-Tyne: William H. Robinson.)

The Taylor-Hobson Outlook. Vol. 3, No. 9, June. Pp. 81-92. (Leicester and London: Taylor, Taylor and Hobson, Ltd.)

Diary of Societies.

WEDNESDAY, JULY 11.

ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (Annual Meeting) (at West Riding Mental Hospital, Wakefield) (continued on July 12 and 13).

PUBLIC LECTURE.

THURSDAY, JULY 12.

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers, Savoy Place, W.C.2), at 8.—Dr. C. E. Kenneth Mees: Physics in Photography.

Sensitometry.—L. A. Jones and Russell: The Expression of Plate Speed in Terms of Minimum Useful Gradient.—O. Sandvik: On the Measurement of Resolving Power of Photographic Materials.—L. A. Jones and Chambers: High-Intensity Time-Scale Sensitometer.—Dr. E. P. Wightman and Quirk: Intensification of the Photographic Latent Image.—Dr. A. Steigmann: Silver Iodide in the Full-Ammonia Emulsion.—Prof. Dr. Emil Baur: Sensitisation and Desensitisation.—Prof. Dr. A. Lottermoser: Observations and Measurements on the Light-Sensitivity of Silver Halide Sols.—Prof. Dr. Fritz Weigert: On the Light-Sensitivity of Photographic Layers.—T. Thorne Baker and Balmain: The Effect of Temperature on the Sensitivity of Selected Photographic Emulsions and the Influence of Wave-length on such Temperature Effect.—O. Bloch: The Interaction of the Silver Halides in Emulsion Form.—Dr. F. C. Toy, and others: On Turbidity.—Prof. Dr. J. Eggert: On Secondary Processes in the Exposure of Silver Halides.—Prof. Dr. R. Luther: Sensitometric Studies.—Dr. F. M. Hamer: A Chemical Study of Desensitisers. Part I. An Account of the known Desensitisers.—Dr. D. A. Spencer: The Ferro-Prussiate Process; The Ferro-Gallic Process; The Diazo-Type Process; A New Application of the Ferro-Gelatine Process; Printing in Colours with Diazo Compounds.—H. W. Lee: The Modern Super-Speed Lens.—S. Jasienski: The Stereoscopic Effect of High-Aperture, Long-Focus Objectives.—N. Fleming: The Photography of Sound Waves.—Dr. Anderson: The Testing of Photographic Shutters; Lens Interferometry.—Prof. Hartridge: The Focal-Plane Shutter.—Capt. C. J. P. Cave: The Photography of Inaccessible Interior Architectural Details with a Spot-Light.—G. Auborne Clarke: The Photography of Clouds.—Prof. E. G. Coker: Photography as an Aid to the Study of Mechanical Stresses.—O. G. S. Crawford: Archæological Photography from the Air.—Capt. M. Hotine: On Photographic Surveying.—Prof. Namias: On Positives by Reversal.—A. R. Hinks: The Work of the Wild Phototheodolite in the Shaksgram.—W. M. H. Greaves: Astronomical Spectrophotometry.—Dr. E. Viterbi: The Fine-grained Emulsion and its Application to Spectrography.—Mr. Elwell: Paper on and Demonstration of Talking Film.—A. J. Bull: Tone Rendering by Half-Tone Processes.—H. M. Cartwright: (1) The Progress of Photogravure Etching; (2) A Method of Colour Correction.—A. A. K. Tallent: Latest Applications of Pyro-Tanning Processes.—E. L. Turner: Modern Photo-Engraving Screens.—William Gamble: The Present Position and Future Possibilities of Photo-Engraving.—H. N. Durham: Mercury Printing Processes.—F. J. Tritton: The Uses of Colour Photography in the Printing Trade.—Prof. Dr. E. Lehmann: On his Two-Colour Process.—Dr. R. von Arx: Dye-transfer Process from Dye Mordant Images.—F. G. Tutton: The Value of the Chromoscope in Commercial Colour Photography.—Commander H. E. Rendall: A Paper on Tri-colour Cameras.—Dr. R. A. Houston: A Paper on the Colour Mechanism of the Eye.—Julius Rheinberg: Demonstration of Micro-Spectra Method of Colour Photography.—F. C. Tilney: Pictorial Photography: the Relation of Technical Advance.—H. Garnet and G. H. Oakden: The Original Binocular Stereoscopic Camera of John Benjamin Dancer.—Dr. E. Kuchinka: W. Fr. Voigtländer's Eight-inch Double-Objective, and other Large Objectives.

JULY 13, 14, AND 15.

MIND ASSOCIATION: ANNUAL MEETING AND JOINT SESSION WITH THE ARISTOTELIAN SOCIETY.

July 13.

At 5.—Mind Association (Annual Meeting) (at Clifton Hill House, Bristol), followed by a Joint Session with the Aristotelian Society, for which the following arrangements have been made:—

Friday, *July* 13.

At 8.—Chairman: Prof. J. A. Smith.—Address by Prof. G. C. Field.

Saturday, *July* 14.

At 10.—Chairman: Prof. Beatrice Edgell.—Symposium: The Nature of the Self and of Self-consciousness. Prof. G. Dawes Hicks, Prof. J. Laird, A. Dorward.

At 2.—Chairman: Prof. J. H. Muirhead.—Symposium: Bosanquet's Account of the General Will. A. D. Lindsay, Prof. H. J. Laski.

At 8.—Chairman: Prof. H. Wildon Carr.—Symposium: Time and Change. J. MacMurray, R. B. Braithwaite, Dr. C. D. Broad.

Sunday, *July* 15.

At 2.—Chairman: Prof. G. E. Moore.—Symposium: Is there a Moral End? Prof. J. L. Stocks, Prof. W. G. De Burgh, W. D. Ross.

At 8.—Chairman: Prof. T. P. Nunn.—Symposium: Materialism in the Light of Modern Scientific Thought. Prof. L. J. Russell, Miss L. S. Stebbing, Prof. A. E. Heath.

EXHIBITION.

MONDAY, JULY 9–SATURDAY, JULY 21.

ROYAL ANTHROPOLOGICAL INSTITUTE.—Exhibition of the Archæological Objects found by Miss G. Caton-Thompson in her Excavations in the Fayum, 1927–1928.

SATURDAY, JULY 14, 1928.

CONTENTS.

The Museums of the British Isles.[1]

SCATTERED throughout Great Britain and Northern Ireland there are 530 museums, all at the service, in greater or less degree, of the public. They represent a great heritage of historical, educational, and intrinsic worth, and, like any other heritage, they impose obligations upon their trustees and beneficiaries alike. That, in the main, these obligations have not been satisfactorily met, is the burden of the report of Sir Henry Miers, made at the instance of the Carnegie United Kingdom Trustees. This outstanding monograph, which bears evidence of careful investigation and constructive thought, ought to mark a stage in the development of British museums, from which definite and rational progress should be made, and for this reason it ought to be in the hands of everyone associated with the control of museums.

The inefficiency of the majority of local museums arises from three sources. In the first place, it may be imbedded in their history, for many began as odd and nondescript collections made by 'collectors,' and many have continued the tradition of their foundation. In the second place, it may arise from indefiniteness of ideas as to the purposes and capabilities of museums in general or of some particular museum. This weakness is especially centred in governing or controlling bodies which, with the best will in the world, may be able to give no useful guidance in the development of the collections of which they are trustees, and at the worst may regard the museum as a home for derelicts, requiring no attention, demanding no progress, a place set aside for moths and dust. The last inefficiency lies in the museum curator himself, who, through lack of knowledge, lack of training, or lack of ideas, may be unable to guide either his collections or his trustees.

With these and the many subsidiary shortcomings of provincial museums, Sir Henry Miers attempts to deal in his report. It is impossible to state in any fullness the many suggestions he makes, but broadly his ideas run towards a great centralising and local decentralising of museum effort. He thinks there should be more museums, since many large towns and populous areas show extraordinary museum deficiency, but he is equally positive that the small, ill-assorted and heterogeneous collections which compose the stock-in-trade of perhaps the majority of little local museums, must give place to

[1] A Report on the Public Museums of the British Isles (other than the National Museums), by Sir Henry Miers, to the Carnegie United Kingdom Trustees. Pp. ii+213+8 plates. (Dunfermline: Carnegie United Kingdom Trust, 1928.)

something better devised to meet the needs of their district.

At the centre of this scheme would stand the great government and national museums, places of rich collections, where the pick of the nation's treasures are to be found, with highly expert staffs and superabundant specimens ready to supplement the efforts and collections of lesser institutions. Next in grade would be central county museums, under the care of "the only body which can hope to provide adequately for the needs of the rural population," the county council. An already existing museum might be selected or a new museum created as the 'county museum,' but the essence of its place in the scheme is that it should become the centre of the county's museum efforts, housing the general collections, directing the scope, and aiding the development of the rural museums in its area, so that wasteful duplication should be avoided and the resources in skill and material of the less populous places be fittingly supplemented.

Last in the series, and providing perhaps the greatest problem of all, are the rural museums. The muddled assortment of bric-à-brac must go, and its place be taken by restricted and discriminate collections selected from a local viewpoint to serve in the best possible way the needs of the immediate district. Each local museum would thus become in the main, if not in entirety, a specialised institution with collections of a specific nature depending upon the idiosyncrasy, scientific, industrial or artistic, of its own limited region. Here we have foreshadowed a development in the museum world of that 'regionalism' which, introduced by Prof. Patrick Geddes, has given a new stimulus to the study of geographical and human relationships.

The scheme is a bold and a fine conception. The question which will arise in the mind of anyone familiar with the museums of Great Britain is, "Is it practical politics?" The difficulties are enormous. At the bottom lies the need of money; money to erect suitable buildings, to purchase and keep first-rate collections, and, most of all, to pay for the services of skilled curators; for no scheme can ever come into being based upon the degraded notions that are too prevalent regarding the qualifications required for the proper conduct of a museum.

There are also other difficulties, of which one of the greatest may be local patriotism. The American museums, some of the best in the world, depend very largely upon charity; and charity must be encouraged, but it has frequently a local flavour. A successful man collects during his residence abroad a fine, perhaps unique, collection of a specific kind, which he offers to the museum of his native town. The museum trustees recognise that it lies without their usual field, but are they to refuse a gift of great scientific and intrinsic value? Still more, are they to set about quenching the smoking flax of interest in their charge?

County councils cannot burden the public rates on behalf of museums to the extent that would be necessary until such time as they have a solid backing of public opinion, and public interest in local museums cannot be aroused until museums offer the people collections and arrangements of collections more instructive and more entertaining than the dry-as-dust medley with which they are too familiar. It is a vicious circle: improve the museum, public interest will be stimulated, and public money will be forthcoming to improve the museum.

There is only one way out, and this is that the first step in the cycle, the bettering of the museum, so that it may be established on an up-grade which will ultimately land it at its due place in the educative and beneficent activities of the State, should be made through the application of funds from an outside source, independent of the public and the rates.

The Medicine of an Aboriginal Tribe.

Memoirs of the Asiatic Society of Bengal. Vol. 10, No. 2: *Studies in Santal Medicine and connected Folklore.* By Rev. P. O. Bodding. Part 2.: *Santal Medicine.* Pp. 131-426. (Calcutta: The Asiatic Society of Bengal, 1927.) 10.11 rupees.

THE Sántáls are one of several aboriginal tribes of India whose home is in the hills of Bihar and Chota Nagpur. Before 1855, when, infuriated by the subtle extortions of the Hindu moneylender, they rose in rebellion (and are said to have shown their valour by standing up fairly with axe and bow to a charge of suppressive cavalry), they were little seen or heard of outside their own jungles. Brave and self-reliant as they are, they live in terror of devils. Though their homesteads in their characteristic villages are well spaced in a long row on either side of a single street, without any cross-streets or unhealthy alleys, they are not exempt from the diseases generally endemic in India or from the common epidemics of the country; and their untutored minds think of disease as caused by devils, which they call *bongas*, and auxiliary witches.

The author of this memoir has lived among the

Sántáls for thirty-seven years and has made a close study of their ideas of the nature and origin of disease and of their ways of treating it. In an earlier memoir (see NATURE, April 3, 1926, p. 499) he explained their views of its supernatural causation, and described in much detail all the rites and breathéd spells by which, in the individual case of illness and as the appointed prelude to any mere medical interference with it, a sort of sorcerers called *ojhas* and *jáns* set about to discover and appease the causative *bonga* and outwit the obstructive witch. In the memoir now under notice, he describes in like detail their more mundane medical methods and apparatus, apart from the incantations of the pale-eyed priest, at the same time leading us to understand that the *ojha* mysteries are an exotic (probably Hindu) imposition, overshadowing this healing art, which —seeing that most Sántáls have some knowledge of it, and that some of its regular practitioners are not *ojhas*—may be regarded as in the main truly indigenous The author has collected this subsidiary medical lore, and has here arranged it in three hundred and five what he calls 'prescriptions,' each 'prescription' referring to a particular deviation from health recognised by Sántáls as a disease, and giving the symptoms of that disease and the directions for its treatment, including the composition of the various medical recipes and, so far as is possible, the scientific names of the ingredients—the whole forming a remarkably interesting compendium of nosology, materia medica, and pharmacy.

The prevalent diseases among the Sántáls are those of all India, namely, malarial fevers, above everything, and the concurrent enlargement of the spleen, parasitic infections of the skin, dysentery and diarrhœa, and cataract and various other affections of the eye: stone is not mentioned, though the multitude of recipes for treating hæmaturia and gravel must surely mean that it is as common there as elsewhere in India. The multiplicity of recipes for 'madness,' epilepsy, and a host of paroxysmal seizures (tiger-convulsions, deer-convulsions, caterpillar-convulsions, etc.), quaintly named after familiar postures of animals, and suggestive of chorea, hysteria, tetany, and catalepsy, point to derangements of the nervous system, the frequency of which must be something peculiar to Sántáls. Syphilis, which is "fairly common," pulmonary tuberculosis, which is "fearfully prevalent," and leprosy, which is "alarmingly" on the increase, all three are said to have been brought in at the time of the rebellion—a convenient date for marking the entrance of some of ... larger industrial stage of India. Epidemics of small-pox, chicken-pox, measles, and cholera are familiar.

The Sántáls have great faith in their medicines, although directions for diet and injunctions to continence occur in some of their 'prescriptions.' They get a few common drugs in the bazaar, but most of their materia medica comes from their own villages and jungles—from common trees and herbs, with a promiscuous assortment of animal products, liquid and solid, and sometimes nasty, contributed by a multitude of beasts, birds, reptiles, frogs, fishes, and a wide variety of creeping things. In all this stuff there is much that is of medicinal value and much that forms the airy basis of a very lively and inventive superstition. Their herbal remedies of most frequent and most diversified use, as judged by continual recurrence in the 'prescriptions,' are trees and plants, many of which are herbs of grace all over India; it is unlikely that the medicinal properties of all of them have been discovered quite independently by the Sántáls.

The superstitious adjuncts of this genuine material, however, illustrate so ingeniously those tricks of strong imagination, those soaring flights of devil-stricken frenzy and fine poetic fancy, that go with a tendency to nervous derangement, that they well may be native to a land where 'eagle-convulsions' is one of the many forms of nervous disorders that afflict the population. A few of the more instructive of these artistic creations of phantasy are the conical prickles of the silk-cotton tree and the warts on the leaves of *Ficus glomerata*, prescribed for small-pox; the juice of the red water-lily for hæmoptysis; the twisted pod of *Helicteres* for colic; the ointment of cicala and mole-cricket for screaming-fits; the scales of a barbel for the crusts of chronic itch; the hair and excrement of the hare for perforated palate; the placenta of the cat for night-blindness; the mud with which the male hornbill blocks the mouth of the cavity wherein his mate is brooding, for cancerous growth; the dirt scraped from a bow for the long-drawn opisthotonic spasms of tetanus; and the tipy egg of the diminutive honeysucker for the marasmus of infants.

The magic touch is obvious in the use of medicinal roots as amulets; and the frequency of prescribing medicines that have to be smeared over the whole body must surely imply the idea of making the patient repulsive or resistant to the *bonga*: many of the medicaments for malarial fever are applied in these two ways. The shadow of the supernatural is also evident in many medical

customs. We may note the obligatory use of the left hand in medical operations; the special tool for digging the root, regarded always as the most precious part of the herb; the occult influence of a virgin's touch: the virtue of the dew and of the melted hail (even in bottle) as particular solvents; the studied disregard of the apothecary's proverbial *jucunde*, shown in the use of putrid rice-water for making-up the sick man's healing draught; and the augury of the fixed day and the brand-new pot for administering a remedy.

In their adroit search for good medicine, however, the Sántáls are not entirely blinded by a superstitious imagination. They are observant and inquisitive. They turn their poetic eye on the sick and wounded animal and consider its ways—what herb it may eat or rub itself against, and live; and they question one another purposefully about a recovery from illness or an ancient scar, and thus acquire knowledge, somewhat after the manner of the ancient Babylonians described by Herodotus.

From the author's account it is plain that, apart from most of the formulated superstition of the *ojha* and the *ján*, pretending to familiarity with the supernatural—which appears to be a Hindu accretion—this aboriginal medicine has some logic and philosophy in it. For albeit that the Sántáls regard evil spirits as the cause of disease, they do not make the sad mistake of thinking of diseases as entities, but look upon them as deviations from health—as a sort of accident—for which their great and good god Cando has provided, most unquestionably, divers natural means of recovery. Although in the quest, as in the usage, of these means his children have stuck pretty firmly to the idea of finding things and ways wherewith to mystify and distract the *bonga*, they have yet managed to discover some things that are really physic to the sick man. So that save in the matter of 'clothes' there is not such a very wide gulf between a Sántál doctor who is deaf to the *ojha* and can retain even the *bonga*, as Mr. Blotton reserved the term 'humbug,' for convenient use in a Pickwickian sense, and medical practitioners of greater pomp and circumstance in countries of more brilliant polish.

The author is much to be congratulated on this diligent research into the medical science and art of a discriminative tribe who in their stories of the creation are said to have placed the English second only to themselves. His memoir will be appreciated by the anthropologist and by the medical man who is curious about the evolution of his calling and is sensible of his ties with the practitioner of a generation not so very far back, who

> "Kepte his pacient a ful great del
> In houres by his magik naturel";

although for his brother whose imagination ranges among hormones and seeks the uttermost parts of biochemistry, it may not have much interest.

Radio Communication.

Wireless Principles and Practice. By Dr. L. S. Palmer. Pp. xi + 504. (London: Longmans, Green and Co., Ltd., 1928.) 18s. net.

LITTLE more than ten years ago it was possible for an industrious plodder to declare that he was acquainted with all the literature of radio communication and that he had studied all the known methods and apparatus thoroughly. To-day, such a claim would be thought to be too ambitious; for the science and practice of radio engineering has been enriched by so many new discoveries and inventions, has found expression in so wide and diverse a literature, that no one mind can possibly now grasp the subject as a whole and in all its details. To point this remark one need only notice that the flow of invention in high-frequency engineering and its related subjects has been so copious since the War that the relevant patent specifications of any one progressive country would make a dozen large tomes. This flood of invention has been accompanied by a corresponding spate of scientific investigation and discussion; and thus, by the way, the recent history of wireless telegraphy affords a large-scale example of the intimate and rapid mutual reactions of science and practice. The largeness of the scale can be seen from the encyclopædic nature of some of the books on radiotelegraphy that have appeared recently.

As a consequence of this expansion in the use and study of high-frequency currents, it has become a heavy task to prepare a treatise which aims, as Dr. Palmer's book does, at making a complete survey of the abstract and applied aspects of the subject of radio communication. In attempting this high task, Dr. Palmer has divided his subject into the divisions which occur naturally to the mathematically minded; and he has built into this theoretical framework as much of the engineering practice as will fit in snugly. The structure thus given to the treatise puts it definitely into the class of college text-books; it is a book for leading the student, rather than for informing the practi-

tioner—for those who wish to enter the temple than for those already in it. Inevitably the book ministers to those who desire to understand the inner laws of plant and apparatus, rather than to those who wish to learn the forms and capabilities of existing constructions. In the opinion of the reviewer, this mode of treatment is the only sound one for training youthful minds for entry into a rapidly developing branch of technology. In other words, the mere description of forms of existing plant is rightly minimised in the present treatise, since most of the existing plant will have become obsolete before the student has developed into the practising engineer. Besides which, and quite apart from this educational aspect, this mode of surveying such a subject, which borrows and adapts a variety of principles from older branches of science, is more compendious than the descriptive method; it has allowed the present text-book to embrace a very wide range of radio communication problems.

When, as is here the case, the subject is too extensive for all of it to be included, the value of a technical treatise, as measured by its utility to the general reader, depends greatly upon the author's discrimination in making his selection of material. The selection ought to be such as to outline and explain all that is truly important in present practice, and as much as possible of what is going to be important in the future. To some extent this is a matter of taste, or, rather, opinion, and demands some slight gift of prophecy. In this latter respect it seems to us that the book is not perfect. For example, there is too little about the merits and demerits of modern developments, such as picture and facsimile transmission, and about the apparatus for carrying it out; again, too little attention is paid to the theory and methods of controlling very short waves in practical circuits and antennæ; and the various methods of rendering a high-frequency amplifier free from self-oscillation are discussed so tersely as to be really useful only to those already competent. Further, the immensely important new methods of frequency control obtained by linking electrical with mechanical oscillators are treated lightly, and their probable influence upon future practice is completely missed; in fact, the subject of piezo-electricity, surely an important practical matter, is almost ignored. It would have been wiser, in our opinion, to have devoted to these important branches of the subject some of the space actually occupied by rather barren algebraic exercises on, for example, oscillating triode circuits.

Leaving aside this question of the selection of the matter and the stress each part deserves, we can very cordially affirm that the book treats in a scholarly, accurate, and lucid manner many branches of wireless telegraphic science, and can be strongly recommended to the student, old or young, who seeks competent guidance into the deeper portions of radiotelegraphic technology.

Birds of Malaya.

The Birds of the Malay Peninsula: a General Account of the Birds inhabiting the Region from the Isthmus of Kra to Singapore, with the adjacent Islands. By Herbert C. Robinson. (Issued by Authority of the Federated Malay States Government.) Vol. 1: *The Commoner Birds.* Pp. l + 329 + 25 plates. (London: H. F. and G. Witherby, 1927.)

THE present work is one of five volumes, in which Mr. Robinson proposes to deal with the birds of the Malaysian region. In the volume under review he describes what he calls "The Commoner Birds," whilst the succeeding volumes will contain respectively: Vol. 2, the birds of the hill stations; Vol. 3, sporting birds, birds of the shore and estuaries; Vol. 4, the birds of the low-country jungle and scrub; Vol. 5, open-country and rice-field birds, migratory birds, and species not included in the above volumes, 'keys' to all the forms from the Peninsula, and a general index to all the volumes.

The average ornithologist, whether he be a museum or a field worker, will probably regret that the birds could not be dealt with in one consecutive whole, as in other books on ornithology. We understand, however, that the format adopted is not as devised by the author, but is written according to the instructions of the Government of the Federated Malay States. The classification employed by Mr. Robinson is that of Sharpe's "Hand-List" (1899–1912), with a certain number of variations according to the author's personal ideas. Unlike most modern systematists, he refuses to accept the Pico-Passeres as an order, with two sub-orders of Scansores and Passeres. The author of this work raises the Owls and Parrots to the rank of orders, and again later on in his work gives the Broadbills, Eurylæmidæ, the same rank. Curiously enough, the whole of the intermediate families of Rollers, Kingfishers, Bee-eaters, etc., he simply places as separate families under no particular order, a convenient and easy method to adopt, but surely not very scientific. The Pittas he includes in the

Passeres, though when commenting on the Broadbills, he remarks that, anatomically, the Pittas and the Broadbills are practically the same, though superficially very different. We cannot quite follow the author in his classification of the various families usually collected in an order often termed the Coracii or Coraciiformes by those who object to a Pico-Passeres group.

Amongst the Passeres there are but few points calling for remark in the author's classification, though we observe that he raises a group of little birds trivially called Ioras, Ægithina, and Green Bulbuls, Chloropsis, to the rank of a family, as had already been done by Stuart Baker forty years ago, when discussing these birds in a journal of the Bombay Natural History Society; this will be probably accepted by most systematists. We are doubtful, however, if some of the names employed by Mr. Robinson are really acceptable. Thus, Gmelin described *Trachycomus zeylanicus* for a bird said to be found in Ceylon, but gives a very indifferent description. This, however, Robinson accepts as sufficient identification for a bird the type locality of which he fixes in Java. Again, Bonaparte described *Ixos erythrotis* as Javan, undoubtedly some form of Bulbul. This, again, Mr. Robinson accepts as sufficient identification for the Burmese form of Otocompsa. It appears to us that these very doubtful specific names should not be accepted.

Before coming to the birds themselves, Mr. Robinson gives us an excellent geographical preamble, describing in considerable detail the various portions of the country included in his work, and there can be very few people who will not be able to learn a great deal from this. He then gives a brief history of the local ornithology and, finally, several paragraphs on nomenclature and orthography, in which he very clearly states his views on the subject.

The book as a whole is well worthy of the great reputation the author already enjoys and, indeed, it would have been impossible for anyone else successfully to have brought out a work of this magnitude on the birds of Malaya. Each bird is dealt with methodically and fully. The descriptions are good without being too long, albeit in dealing with minor points, such as range, nidification and habits, each species is treated in the same way, and the letterpress is accordingly very easy to follow.

In closing this volume, one feels that though so much admirable work has been carried out by Mr. Robinson and his fellow-workers in museums, an enormous amount of work still remains to be done by field workers. For the most part, except for records of the field work done by Messrs. Robinson and Kloss, the volume is a record of skins. Mr. Robinson himself refers to this, and we join with him in the hope that the present volume will stimulate others to fill in the many gaps in the biological history of the birds of Malaya.

Every work written is merely the basis for further work, but we feel that in the present volume the nomenclature will be found to be, on the whole, extraordinarily accurate, whilst the field worker of the future will not be distracted by constantly having to alter names of the birds the habits and nidification of which he is trying to learn. We congratulate Mr. Robinson on having been completely successful in bringing out a work which is very badly needed and one which will undoubtedly, for many years to come, be the standard work of the birds of the Malay region.

A New Dictionary for the Technical Translator.

Pitman's Technical Dictionary of Engineering and Industrial Science. In seven Languages—English, French, Spanish, Italian, Portuguese, Russian and German. Compiled by Ernest Slater. Complete in about 36 fortnightly Parts. Part 1. Pp. x + 70. Part 2. Pp. 71-134. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 2*s*. 6*d*. net each Part.

THE translator of technical literature, whether he be a specialist in his own branch of science or technology, or merely attempts to be an interpreter of other people's endeavours in the world of science and industry, feels the need of a comprehensive technical dictionary in which he will be sure of finding the word he wants. This new dictionary sets out to cover that want, by giving in one set of volumes (when complete) all the important technical terms used in a wide range of arts and sciences. It is arranged on an English basis, that is to say, the English terms are given first, in alphabetical order, followed by the equivalents in the six other languages. Here, we think, the publishers have made a grave mistake and considerably curtailed the scope of the work, because most of the translator's work consists in translations from the foreign idiom into his own language. Unless the publishers include an index at the end, giving all the words listed in every language, then the dictionary will be confined in its utility to translations made by Englishmen into the foreign language, or similar translations made by the foreigner into his particular language.

It is difficult, from a perusal of the first two parts, to criticise a work of this kind fairly; but, as a whole, the dictionary includes most of the words one is likely to want. There are, however, a few mistakes and lacunæ, to which we should like to direct attention. Under the heading "air," or "airless," one would naturally expect to find the modern expressions "airless injection oil engine"; "air, blast" (that is, the blast air used in large Diesel engines); or to find the term usually employed in German for "(ventilation) air duct," namely, *Lutte*; but one is disappointed. Again "air capacity, free," that is, the free-air capacity—the usual rating for a compressor—might have been given under *air* as well as under *free*. Then there is a tendency to use the Latinised equivalent, instead of the purely Teutonic word in German; for example, "amplitude of swing" is given as *Schwingungsamplitüde*, where the more common forms *Schwingungsweite* or *Schwingungshöhe* are preferable. In their endeavours to use the native word, the Germans are now even using *Vomhundertzahl* or *Vomhundertsatz* in place of the Latin-German *Prozentsatz*. Similarly with the motor expression *Fussakzelerator* for accelerator, instead of the less clumsy *Beschleunigungspédal*. *Schraubenbefestigung* for "screwed-on attachment" ıs scarcely correct, the appropriate word being *ıngeschraubter Anschluss*.

In an introduction dealing with the technical ranslator's art, some valuable hints are given for he user of the dictionary and some of the pitfalls xplained. When, however, the compiler states that he "velocity of a falling body" cannot be transıted literally into French with pleasing effect, nd he suggests instead *vitesse de chute d'un grave*, e departs from the strictly scientific. Physicists ı their text-books actually do use *vitesse d'un rps tombant* or *qui tombe*. Referring to the fficulties attending the translation of the word standard," it should be noted that the Germans e the prefix *Normal-*... (*Normalmasstabe*—andard rule, *Normallehre*—standard gauge; *rmalelement*—standard cell), and that *standards* German are *Normen* (cf. *Normenausschuss für die utsche Industrie* = German Engineering Standards mmittee).

These few criticisms apart, the work covers exmely well the ground it sets out to cover, and inclusion of the Portuguese equivalents will be real value to those who have occasion to make hnical translations for Portugal, Brazil, or rtuguese East Africa.

E. S. Hodgson.

Our Bookshelf.

Die Bahnbestimmung der Himmelskörper. Von Julius Bauschinger. Zweite Auflage. Pp. xv + 671. (Leipzig: Wilhelm Engelmann, 1928.) 59 gold marks.

The outstanding literature of a comprehensive and practical nature on the subject of the determination of orbits of celestial bodies is contained in five books—Gauss's "Theoria Motus" (1809), translated from Latin into English by Admiral Davis in 1857, Watson's "Theoretical Astronomy" (1868), Oppolzer's celebrated "Lehrbuch" in two volumes (1870 and 1880), Klinkerfues's "Theoretische Astronomie" (1871), and finally, the first edition, in 1906, of the volume now before us. All of these were out-of-print, but it is gratifying to note that the most recent has reached a second edition.

Bauschinger's treatment of the subject is a model of simplicity and orderly design, the needs of the practical computer being kept constantly in view. In the early chapters a thorough foundation of spherical and dynamical astronomy is laid. A third of the book is devoted to the laying down of the principles that are to be employed in the actual determination of orbits. The development of the principal subject is clear, concise, and well illustrated by examples. The determination of definitive orbits and of special perturbations also finds a place.

What is perhaps most disappointing is to find so little revision in a work that has enjoyed a deservedly high reputation as the most up-to-date on its subject. Developments of the past twenty years have been dismissed in a few lines each, and some not even mentioned. We should have expected a description of the perturbation method of Cowell and Crommelin, which was used so successfully for the prediction of the return of Halley's Comet, and earned the award of the Astronomische Gesellschaft prize; it is not even mentioned, although that of Noumerov, which is merely a modification of Cowell's, is quoted as a "méthode nouvelle." The work of the American school under Leuschner is merely cited in a reference. No attempt has been made to describe the simplifications that are rendered possible by the use of calculating machines. The author, in his preface, states that this course has been adopted deliberately, and is careful to point out that it is not due to ignorance of the new methods that have been so summarily excluded.

In view of the non-existence in the English language of any suitable text-book on this subject, a translation of the work would be most welcome.

L. J. Comrie.

Science and Ethics: Conway Memorial Lecture delivered at Essex Hall, Essex Street, Strand, W.C., on April 18, 1928. By J. B. S. Haldane. Pp. 46. (London: Watts and Co., 1928.) 2*s*. net.

The number of professional scientific men who realise vividly the importance for ethics of the work they are doing is probably not large; we

may therefore be grateful to Mr. J. B. S. Haldane for dealing with the subject in his Conway Memorial Lecture. He holds that science impinges upon ethics in at least five different ways: (1) It creates new ethical situations; (2) it may create new duties by pointing out previously unexpected consequences of our actions; (3) it affects our whole ethical outlook by influencing our views as to the nature of the world; (4) scientific anthropology is bound to have a profound effect on ethics by showing that any given ethical code is only one of a number; (5) it will evidently favour ethical principles and practices which transcend the limits of nation, colour, and class.

Mr. Haldane holds that the greatest danger to which our ethical system is exposed from science is the deliberate exploitation of scientific ideas in the interests of unscientific prejudice. In this connexion he regards with particular misgiving the application of ill-understood principles of genetics by eugenist amateurs. We do not yet know enough about the inheritance of mental ability to say that a few generations of selection against it would have appreciable results; and "the dictates of biology are on the whole in line with those of humanitarian ethics." Eugenics certainly has "a very great future as an ethical principle," as has hygiene, but the successful application of a principle demands exact and complete knowledge, and this we cannot be said, as yet, to possess. J. C. H.

Introduction to Theoretical Physics. By Prof. Arthur Haas. Vol. 1. Translated from the third and fourth editions by Dr. T. Verschoyle. Second edition. Pp. xiv + 333. (London: Constable and Co., Ltd., 1928.) 21*s*. net.

THE first English edition of the treatise by Prof. Haas received commendation in our issue of Aug. 22, 1925, and the fact that a second edition has already been called for is sufficient testimony to the value of his work. A comparison between the two editions shows that the revision has been carefully carried out. The most important alteration is the addition of part of a section on the Hamiltonian function and the canonical equations of motion. It *is* a striking tribute to the almost superhuman genius of Hamilton that his work is continually finding fresh applications; his powers of generalisation were such that even to-day his methods are being used in developing the new quantum mechanics and the wave theory of matter. Some twenty years ago Lord Rayleigh commented on the long-continued neglect of Hamilton's work on optics, and remarked that he "allowed his love of generality and of analytical developments to run away with him." Certain it is that much loss has ensued from ignorance and neglect of work already done.

The English student will welcome the new edition of the "Introduction to Theoretical Physics," because it gives him in convenient form such a lucid account of those branches of mathematical physics which are of outstanding importance at the present time. H. S. A.

Plant Ecology. By Prof. W. B. McDougall. Pp. 326. (London: Henry Kimpton, 1927.) 14*s*. net.

THIS text-book is designed to serve as an introduction to the ecology of plants. It treats the subject of plant life comprehensively rather than intensively, and the term 'ecology,' defined as "the science of the interrelations of living things and their environments," is given a wide connotation. Chapters ii.-ix. deal mainly with the structure and autecological relationships of plants. They form a good introduction to general botany from the ecological viewpoint. The physical factors of the environment are dealt with in the succeeding five chapters, and the last third of the book summarises various aspects of synecology. A useful, but too brief, appendix contains suggestions for the teacher concerning laboratory and field work. An index is provided and the text is illustrated by 114 figures. References to selected literature (in English only) are given at the ends of most of the chapters. The book can be heartily recommended to teachers in Great Britain, though it has one drawback: that many of the examples quoted, both of individual species and of plant communities, are endemic to North America, and are therefore probably unfamiliar to the English student. W. B. T.

Röntgenstrahlen (Physik, Technik, und Anwendungen). Von Dr. Richard Herz. (Sammlung Göschen, Nr. 950.) Pp. 136 + 16 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1927.) 1·50 gold marks.

THIS volume fully maintains the standard set by earlier members of the series, and provides the usual mine of condensed but accurate and eminently readable information. Almost one-half of the book is devoted to the physics of the subject, and the remainder to the technique of the production of X-rays, and to their medical and technical applications. The ground covered is approximately that of the Cambridge Diploma in Medical Radiology, but the sixteen pages of excellent plates, mostly of tubes and installations, will make it of particular value to readers who have not the opportunity to see or use elaborate apparatus of this type. One wishes that there existed an equally good and inexpensive treatment of the subject in

The Great Physicists. By Dr. Ivor B. Hart. Pp. vi + 138. (London: Methuen and Co., Ltd., 1927.) 3*s*. 6*d*. net.

THIS book, from an experienced writer, is the first of a series, now in preparation, entitled "The Great Scientists," which is to survey in requisite departments the main achievements of scientific progress from early to modern times. The historic sense in Dr. Hart's narrative is well preserved. We notice (p. 64) that 1660 instead of (correctly) 1662 is given as the date of incorporation of the Royal Society. Also (p. 112) the name Tyndal should read Tyndall. The book is handy in size and well printed.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Influence of Forest Formation upon Soil Moisture.

IN the discussion upon Dr. C. E. P. Brooks's interesting paper, "The Influence of Forests on Rainfall and Run-off" (*Quart. Jour. Roy. Met. Soc.*, **54**; 225), Mr. W. Vaux Graham (p. 16) states that three springs near Tosson, Rothbury, clearly shown on the 1863 edition of the 6-inch Ordnance map, were not marked upon that of 1896, and now had almost ceased flowing. He suggested that the formation of a large spruce plantation on the hillside just above the springs was responsible for the diminution in flow. Dr. Brooks replied that there may well be isolated instances in which the planting of trees would affect the flow of springs adversely, and this would naturally result if they were planted in ground formerly bare or occupied by xerophytic vegetation. Numerous examples could be cited, however, in which it had been claimed that the *cutting down* of trees had had the effect attributed by Mr. Vaux Graham to the planting of trees, that is, the cessation of springs.

In view of this discussion, the following data relating to the influence of various species of trees upon the soil moisture may be of interest.

In my experience the moisture content of soil of one and the same general physical type will either increase or decrease according to the original nature of the substratum—that is, whether it was a free water surface, a sandy waste, a bare rock surface—and the plant succession. Lithoseral and psammoseral successions—those beginning on bare rock surfaces and on pure sand, respectively—react physically and chemically upon the substratum stage by stage, the principal feature being the addition of soil moisture; such addition continues until the climax community is developed. On the other hand, hydroseral successions—those taking place in free water, or on very moist soils—bring about the gradual drying of the soil: until the development of the climax stage limits this reaction. Thus the planting with trees of a hydroseral site—that is, the hastening of the succession to a climax either artificial or natural—brings about a certain loss in soil moisture, whereas the planting of lithoseral and psammoseral sites increases *the moisture content, unless the species employed be* foreign to the normal succession. Water-voracious indigenous plants not natural to the particular sere, and demanding exotics, draw strongly upon the soil moisture no matter what the successional history of the site.

The degree of moisture absorption by the roots of trees has to be taken into account in the study of the reactions of all forests, natural and artificial. Although this was realised to some extent so early as 1856 by Cotta, and remarked upon by Borggreve in 1891, it was not until Fricke (1904), Albert (1915), Barrington-Moore (1917), Hans Burger (1923), Aaltonen (1923), and myself (1922–27) had investigated the matter experimentally, that the potent draining effects of certain tree stands were brought to light. No details can be given here, but the following mean moisture content data for adjacent sites bearing different types of vegetation—the soil being of the same general nature throughout—are instructive in demonstrating the reactions of different tree communities:

Vegetation.	Mean Moisture Content (per cent). At 6 inches.	At 24 inches.
Macchia ('fijnbos') shrubs to 10 ft.; the medial stage of the sere	35	26
Primeval forest of medium moist type: the climax for the sere	42	35
Plantation of *Pinus insignis* Doug. (*P. radiata* Don.): about 14 years old; planted 6 ft. × 6 ft., and much thinned	34	24
Plantation of *Pinus pinaster*: about 14 years old; planted 6 ft. × 6 ft., thinned once	33	24
Plantation of *Eucalyptus globulus*: about 14 years old; thinned thrice	25	20
Plantation of *Acacia melanoxylon*: about 14 years; thinned twice. (For a full account of the behaviour of this species, see J. F. V. Phillips, *Trans. Roy. Soc. S.A.*, **16**, 31-43; 1928.)	18	16

From the foregoing it is clear that planting of *Eucalyptus globulus* and *A. melanoxylon* would very seriously decrease the soil moisture, whereas the planting of the pines would affect this but slightly.

Furthermore, I have been able to collect information regarding the drying of numerous small streams in the George-Knysna-Humansdorp coastal region, as the outcome of the planting of various species of *Eucalyptus*, and the planting of *A. melanoxylon*; on the other hand, appreciable diminution of flow due to the formation of blocks of *Pinus insignis* and *P. pinaster* has not been detected—during periods of normal rainfall. In dry periods, however, a minor drying influence is demonstrable.

Clear or selective fellings in natural and artificial forest often produce appreciable increase in soil moisture at depths greater than 6-9 inches—provided strong weed-growth or rapidly developing coppice shoots do not appear; this increase is due to decreased absorption by the roots. The following examples must suffice:

Vegetation.	Mean Moisture Content of Soil at 12 Inches (per cent). Before Felling (: *x* : 1).	2 Months after Felling (: *x* : 1).	2 Years after Felling (: *x* : 2).
Primeval forest of medium-moist type	38	50	42
Acacia melanoxylon	17	25	19

(: *x* : 1) mean values from numerous determinations over 1 month.

(: *x* : 2) dense weed-growth and vigorous coppice produced on both sites.

As pointed out by Mr. Vaux Graham, the loss of moisture by interception of rainfall by trees is worthy of consideration; observations at Deepwalls, Knysna, have shown that from 10 to 25 per cent of the fall fails to reach the ground, being spread over the surface of the foliage, the twigs, the branches, and the boles of the trees.

The losses due to absorption and interception at

Deepwalls are all the more interesting because at least 15 inches of precipitation are added to the ordinary rainfall as the result of condensation by the forest canopy of hydrometeoric mists.

JOHN PHILLIPS.

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(Formerly Forest Research Station,
Deepwalls, Knysna, S.A.),
May 21.

The Complex Structure of the Copper–Tin Intermetallic Compounds.

THE equilibrium diagram of the copper–tin system is one that shows a bewildering complexity of phases. The great majority of these exist only at high temperatures or form solid solutions of variable composition, but there exist at ordinary temperatures three phases which show a very limited range of composition. These have been usually considered by metallurgists, following the classical work of Heycock and Neville, as the intermetallic compounds: δ bronze Cu_4Sn; η bronze Cu_3Sn; and ϵ bronze CuSn.

Recent studies of these compounds by the method of X-ray analysis of single crystals have been carried out partly at the Davy Faraday Laboratory and partly in the Department of Mineralogy at Cambridge with the invaluable assistance of the Department of Metallurgy. It has been shown conclusively that definite intermetallic compounds exist, but that their compositions and structures are much more complex than those usually assigned to them. The complexity is such that the complete structural analysis will take some considerable time, so that it has seemed of interest to give the following preliminary results.

The compound δ bronze has been most carefully studied from some minute single crystals without faces prepared by Dr. Weiss; it is found to have a cubic structure with a face centred lattice of side 17·92 A., thus confirming the powder photograph observations of Westgren and Phragmen (*Ark. f. Mat. Ast. u Fys.; K. Sven. Vet. Akad.*, 19 B, No. 12; 1926). With a cell of this large size it is difficult to be certain of the number of atoms in the cell. However, its close relation to the structure of γ brass worked out by Bradley and Thewlis (*Proc. Roy. Soc.*, A, 112, 678; 1926), which has a cell of almost exactly half the dimensions, 8·87 A., and gives intensities of reflections for the 50 corresponding planes of almost identical values, makes it almost certain that the total number of atoms in the cell is $8 \times 52 = 416$. Such a number cannot be made up from molecules of Cu_4Sn, and the most probable values to fit with the density 8·95 are 328 atoms Cu and 88 atoms Sn, which makes the simplest formula $Cu_{41}Sn_{11}$. In order to check this, Mr. J. Stockdale has kindly carried out a micrographic analysis of a set of specimens of composition ranging from 19 to 22 atomic per cent tin at 0·2 atomic per cent intervals, and annealed for three weeks. He has found clear evidence of a two-phase structure, except in the case of the specimen containing 20·6 atomic per cent tin, which agrees very closely with the value found by X-rays. In any event, it is clear that the formula Cu_4Sn must be abandoned; its retention up to the present being due on one hand to insufficient annealing, and on the other to the desire for a simple formula. The positions of the atoms in δ bronze are very similar to those in γ brass. They have been found with sufficient accuracy to give a reasonable account of the 700 observed plane intensities. The space group is T^2_d.

The compounds η bronze and ϵ bronze were examined in the shape of single crystals prepared by Mr. Heycock by dissolving alloys of appropriate composition with concentrated hydrochloric acid.

η bronze grows in lath-shaped crystals with corroded faces sufficiently good, however, to show that the symmetry is orthorhombic. This is confirmed by X-ray analysis, which shows a cell unique outside organic crystals, $a = 4·33$, $b = 5·55$, $c = 38·1$ A. There is, however, a pseudo cell with the same a and b axes, but with the c axis 4·76 A., one eighth of the true value, the dimensions of which resemble nearly a close-packed hexagonal arrangement. This is the structure found by Evans and Jones (*Phil. Mag.*, 4, 1302; 1927) by the powder method, which is of course powerless to deal fully with a structure of such complexity. In this case the accepted composition is probably correct, analysis of the actual crystals giving 25·2 atomic per cent tin, which gives 16 molecules of Cu_3Sn per cell. Micrographical analysis, however, gives 24·3 per cent, which agrees better with the formula $Cu_{50}Sn_{16}$. The lattice is *bc* face centred Γ^1_o, and the space group probably Q^{17}_h.

ϵ bronze grows in beautiful needles, which, measured optically, show hexagonal symmetry. Its structure is the most curious of all the compounds. The lattice is hexagonal Γ_h, $a = 20·85$, $c = 25·1$ A., very closely simulating one of one fifth of these dimensions. Such a cell would contain two molecules of CuSn with a nickel arsenide structure. The composition in this case, however, differs widely from CuSn. Analysis of the crystals gives 45 atomic per cent tin, while micrographic analysis leads to the value 46 atomic per cent. With a density of 8·27 the cell has from 230 to 250 atoms of tin and 280 to 300 of copper, the simplest formula being 50 Cu_6Sn_5, but further study will be required to arrive at the exact numbers.

From these studies two things appear; there is first the extreme regularity of the internal structure of compounds that repeats exactly with cells of such magnitude and of such complex composition, and secondly, there is a distinct tendency to mimic much simpler cells: cubic close packing in the case of 'Cu_4Sn,' hexagonal close packing in the case of 'Cu_3Sn,' and a nickel arsenic structure for 'CuSn.' The second property is plainly the same as exists in the more usual metals and compounds such as the silicates, in this case connected with the ratio of the free electrons of the atoms of tin and copper as suggested by Bradley and Gregory (*Proc. Manch. Phil. Soc.*, 72, 91; 1928). The extreme complexity is in the author's opinion due to some incommensurability in the atomic diameters which cannot adjust themselves in less than a certain number of atomic steps.

J. D. BERNAL.

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Quality of Soil in Relation to Food and Timber Supply.

THE statement made by the "Writer of the Article" in NATURE of June 2, to the effect that no land should be planted which is capable of providing food, is surely a very sweeping one if applied literally to the British Isles. The "Writer" doubtless knows that a mild and humid climate enables ground to be utilised for grazing in Ireland which would be practically worthless under more arid conditions. This means that food production is not confined to good land, and sheep in particular can and do produce large quantities of meat on land which is even too poor and exposed for timber production. The relative advantages of food and timber production

for land utilisation are not, therefore, determined merely by the quality of the soil, as is suggested by the "Writer of the Article," but by other considerations, some of which are referred to by Mr. Hiley.

Over and above these points, the remark raises the question whether timber-growing on poor soil is necessarily accompanied by any economic advantage. For the best part of a century economists and foresters have adopted a theory that land considered too poor for agriculture can be advantageously devoted to afforestation. The economist argues, of course, that food is a more essential production than timber, but a similar argument might be used in connexion with hundreds of articles or industries now considered necessary to civilisation, which take up or occupy land capable of food production. Why should timber alone be prohibited from occupying land of a class which is equally difficult to prove suitable for one particular purpose to the exclusion of others? From the forester's viewpoint the theory referred to has been advanced chiefly to justify his existence, and rests on no firmer foundation than that provided by the economist.

The precise qualities which render certain soils more productive under timber crops than when devoted to tillage or grazing are not easily defined, and the question is so extremely complex that its discussion here would be quite impossible. But a great advance could be made in the broader issues of rural economy if a general agreement could be arrived at on one particular aspect of the question. This is the scientific principle which should be recognised in all forms of land utilisation, so far as this affects land control. Why, for example, does the State persistently ignore the most important asset the country possesses by disregarding all forms of control over land, and leave the disposal or utilisation of this asset entirely to the individual? The correct answer is probably that the matter is too big for our statesmen to tackle. The argument is always forthcoming that the pressure of necessity or supply and demand will invariably settle the problem on general lines in the long run, and the individual occupier must decide for himself whether corn, grass, forest, fruit, or garden produce is giving the best return to the country at large, as well as to himself. The mere fact that this is the only practical solution of the problem is, however, no proof that it is the correct one. It merely proves that land utilisation is still governed by self-interest, tradition, or empiricism rather than science, and that force of circumstances, negligence, or some other factor is responsible for a certain percentage of the natural fertility of the soil remaining unutilised.

If the covering of the soil with a tree crop is the objective, irrespective of profit, quality, or size of timber, or the production of commercial material, the problem is narrowed down to selecting a species which is capable of normal existence on the particular land being dealt with. An objective of this kind may be connected with the prevention of soil erosion, regulation of water supply, climate, or landscape effect, etc., and soil fertility is then a subsidiary question. If, on the other hand, the production of commercial timber is aimed at, soil fertility in relation to the particular crop or species is of considerable importance, taking, of course, elevation, aspect, etc., into consideration. Every timber tree requires certain conditions for its normal development, in the same way as any other plant, but there is no evidence, so far as I am aware, that timber trees are less exacting as regards soil fertility than the majority of farm crops, due allowance being made for the fact that the latter can only utilise the first few inches of surface soil, and must, therefore, maintain themselves from a layer in which soil nutrients are concentrated rather than diffused, while the former have a deeper rooting range. Different species of trees differ, of course, in their requirements, but if the total amount of nutrient material extracted from the soil could be compared with the dry weight of vegetable matter it produces, the probability is that timber trees would be found to make similar demands upon soil as is the case with farm crops. Young trees growing in nurseries afford an illustration of this, for the average tree nursery requires cultivation and manuring to as great an extent as oats or potatoes, otherwise the crops fail.

Those who favour the theory that soil fertility is less important for trees than for farm crops, overlook the fact that the bulk of the commercial timber in Europe is growing on soils which are by no means poor, and that the assumed poverty of much forest land is based on appearances rather than facts. Rocks, boulders, uneven ground, steep slopes, etc., which obstruct or prevent ordinary cultivation, do not necessarily imply poor soil. Many of the forests pointed to as examples worthy of imitation grow on land equally as good as agricultural land in their vicinity, and the preservation of the forest has been due to causes quite distinct from soil conditions.

The theory that forest should occupy poor land only is merely sound so far as it is required as a surface covering for various purposes, irrespective of timber production. Where the latter is the main object in view, the tree crop should occupy land capable of meeting, but not exceeding, its requirements for normal growth. No economic advantage is gained by planting land below the standard of quality required to produce a satisfactory crop, and a country cannot both have its cake and eat it. Either the commercial forest must disappear, or land of suitable quality must be set aside for its use, and in the majority of cases this land will have a not inconsiderable agricultural value, and is consequently capable of food production if cleared or left unplanted.

Nature does not recognise these sharp divisions between agricultural and forestry land, but too often scrub or worthless timber is regarded by the layman as satisfactory forest, and the distinction between commercial and non-commercial timber ignored or unrecognised.

A. C. FORBES.

Dublin.

Silver Bubbles and Films.

IT may be of interest to record a phenomenon observed in the course of an experiment on the properties of 'sputtered' silver films. On the passage of a discharge through the sputtering tube, it was noticed that numerous 'globules' of varying sizes—some transparent, others iridescent—made their appearance on the walls of the vessel.

A casual glance suggested the presence of a condensed liquid, but a more detailed examination revealed the supposed globules as very thin films of metal which had entrapped a finite volume of gas. Many of these 'metallic skins' showed brilliant interference colours by reflection, whilst others were so thin as to appear almost transparent when viewed by transmitted light. The shape of the deposited films varied, the majority being circular, while some were elongated, giving an appearance similar to that of blistered paint. This characteristic formation is shown in the accompanying photograph (Fig. 1).

The average diameter of the deposits was found to be 6·0 mm., the largest oval formation being

13·0 mm. long by 6·0 mm. wide. The fact that a continuum of metal having so large an area can be spontaneously deposited on the glass walls is of great interest, since it points to a perfectly homogeneous film structure.

The films were kept under observation for several hours, and were found to undergo a progressive transformation due apparently to gas diffusion through the metal, the skins slowly shrinking, and finally puckering. On passing a further discharge at this stage, the flaccid films became electrified, and consequently disrupted by contact with the walls of the tube. The continuous formation of minute gas bubbles upon the surface of the 'envelopes' confirmed the supposition of a gas diffusion through the film.

FIG. 1.—Silver bubbles produced by discharge through a 'sputtered' tube. Twice natural size.

Evidence of a granular structure in the metal deposit was sought, but was not confirmed by observation with a high-power microscope. An attempted measurement of the thickness of the films by observing the interference colours produced was rendered abortive, owing to a general 'browning' of the glass walls, but since a thickness of approximately 0·3 μ is requisite for visible interference phenomena, it is apparent that the observed deposits approximated to molecular thickness.

The discharge was maintained at a pressure of 5×10^{-3} mm. of Hg, using a 10 in. coil, with mechanical 'make and break,' to excite the tube.

D. R. BARBER.

University College, Exeter,
June 16.

A Century of Inventions.

PERUSAL of Sir Alfred Ewing's masterly review of "A Century of Inventions" (NATURE, June 16) brings to mind the singular accuracy with which Erasmus Darwin (1731–1802) foretold some of them. The forecast lies buried in his poem, "The Botanic Garden, or the Lover of the Plants," which incurred Canning's merciless parody, "The Loves of the Triangles," and was pronounced by Byron to be "pompous rhyme."

"The Botanic Garden" was published in 1789, fifteen years before Trevithick first made a steam carriage to run upon rails. Darwin did not live to see that, nor did he foresee the internal combustion engine; but his prophecy was of remarkable range.

> "Soon shall thine arm, Unconquered Steam, afar
> Drag the slow barge and drive the rapid car;
> Or on wide-waving wings expanded bear
> The flying chariot through the fields of air.
> Fair crews, triumphant, leaning from above,
> Shall wave their flutt'ring kerchiefs as they move;
> Or warrior bands alarm the gaping crowd,
> And armies cower beneath the shadowy cloud."

HERBERT MAXWELL.

Monreith.

IN the thirty-fourth James Forrest Lecture, delivered by him before the Institution of Civil Engineers on June 4, Sir Alfred Ewing omits to mention the source from which he has borrowed his title. The historian of science is not likely to forget that remarkable memoir, "A Century of Inventions" (1663), in which the steam-engine is first described. It has been often reprinted, and under this name, an abbreviation of the original has been translated into several European languages. The author, Edward Somerset, second Marquess of Worcester (1601–1667), was eldest son of Henry, the first marquess, by Anne, second daughter of John Lord Russell and of Elizabeth, third daughter of Sir Anthony Cooke, Knight of the Bath. By virtue of their common descent from the last-named statesman, he was a cousin once removed of Francis Bacon, Viscount St. Alban. His only son, Henry Somerset, first Duke of Beaufort, was a maternal ancestor of Augustus Fitzroy, third Duke of Grafton, grandfather of Admiral Fitzroy, the eminent meteorologist.

THURKILL COOKE.

5 Cavendish Square, W.1.

MR. THURKILL COOKE is of course right in saying that I borrowed the title of my recent James Forrest Lecture from the Marquis of Worcester's well-known book. The title is so familiar in that connexion to students of engineering history that I imagined my audience did not need to be reminded of its origin. Mr. Cooke will find a reference to the original "Century of Inventions" in my book on "The Steam-Engine and other Heat Engines" (p. 4), where a brief sketch is attempted of early stages in the evolution of the steam-engine.

J. A. EWING.

Valence and the Rule of Eight.

F. LONDON, in an interesting article (*Zeit. f. Physik*, 46, 455; 1928), attempts to account for the difference in valence behaviour between nitrogen, oxygen, and fluorine on one hand, and phosphorus, sulphur, and chlorine on the other, in terms of absolute quantum restrictions. The chemist has been inclined to account for the limited valence of nitrogen, oxygen, and fluorine on the grounds of energy relations; that is, many compounds do not occur because they are 'unstable.' Such an explanation is admittedly unsatisfactory.

London's main premise is that the 'homopolar' bond between two atoms consists of a pair of electrons, one of which is contributed by each atom. If two electrons belong to the same atom and are 'paired,' that is, neutralise each other magnetically, they are not available as a bonding pair to form a link with another atom. This is, of course, quite a different postulate from the one made by G. N. Lewis, who assumed that the pair of electrons in the bond might both belong to one atom. London's postulate works well in that he can show that fluorine has only one 'free' electron, while chlorine may share as many as seven pairs of electrons in perchloric acid. This latter assumption, however, abrogates the rule of eight, which has its physical basis in the stability of the electron structure of the noble gases and is, after all, one of the main principles of the Lewis theory.

Apparently London naïvely accepts the old valence theory, which assumes that an element will show a different valence toward oxygen than toward hydrogen, without realising that this behaviour calls for some explanation. If HClO, exists, why not H_5Cl? The Lewis theory accounts for all this very nicely by the rule of eight.

Furthermore, oxygen and fluorine form compounds

with valences greater than two and one respectively. These cases would be disposed of by London, perhaps, as not being all 'homopolar' in type. Nitrogen, however, according to London, should have but three electrons to share, and nitric acid and the amine oxides appear to offer difficulties.

By giving up the rule of eight a few facts can be accounted for on grounds more definite than those of energy relations. But it may be expected that when a rule which has been found applicable to hundreds of thousands of compounds is given up, new explanations must be invented for the existence or non-existence of various chemical structures, and some of these explanations will probably involve *ad hoc* assumptions.

WORTH H. RODEBUSH.

Laboratory of Physical Chemistry,
University of Illinois, Urbana, Illinois,
May 29.

The Raman Effect and the Spectrum of the Zodiacal Light.

IN a recent address (*Indian Journal of Physics*, vol. 2, part 3, p. 387) Prof. C. V. Raman announced the interesting discovery that when monochromatic light is diffused by the molecules of a liquid, the spectrum of the scattered light contains, besides the incident lines, also other new lines of increased wave-length. The Raman effect, as it may be called, is less easily observed in the case of scattering by gases and vapours. Nevertheless, I have succeeded in photographing a satisfactory spectrum of the light scattered by the vapour of ether showing the effect. For this purpose, a specially constructed spectrograph of small dispersion and very large light-gathering power was used. With a 3000 c.p. mercury vapour lamp as the source, an exposure of 186 hours on the light scattered by a flask of ether vapour brought out the most prominent line of increased wave-length very clearly. The intensity of this line in relation to the incident line which excites it is considerably less in the case of the vapour than in the case of the liquid.

The spectrograph constructed for the research mentioned above proved itself equal to the task of photographing the spectrum of the zodiacal light with less than an hour's exposure, fast plates sensitised with erythrosine being used. The plate showed a continuous spectrum, with the calcium absorption line at 4227 A. prominently appearing in it. The spectrum showed no trace of light of wave-lengths longer than about 5000 A., though the plates were sensitive up to the *D* lines. The complete absence of the longer wave-lengths makes it difficult to accept the suggestion of Dufay that the particles to which the zodiacal light is due are larger than the wave-length of light in size. It is more reasonable to assume that the scattering material is diffused in atomic or molecular condition. Since the radiation incident on the diffusing molecules includes very short wave-lengths, the scattered radiation from them penetrating through the earth's atmosphere must include not only the incident frequencies, but also radiations of modified frequencies which are less perfectly polarised. The weakness of polarisation of the zodiacal light can be reasonably accounted for in this way. It appears not improbable, therefore, that the Raman effect is of significance in relation to the spectral character and polarisation of the zodiacal light.

L. A. RAMDAS.

20 Kutcheri Road,
Karachi, May 29.

Imperishable Labels for Preserved Organisms.

WHEN paper labels are used for describing the contents of a bottle containing animals, especially those obtained on expeditions and not examined until many years after the material is preserved, it is not infrequently difficult to read the labels with certainty. Valuable material is sometimes lost from this cause. Moreover, the writing of paper labels out-of-doors in wet weather under pressure of time and material is irksome and inefficient. No doubt there are many ways of overcoming a minor difficulty of this kind, but it is probably not superfluous to record a successful method which may not be known generally and has been extended in this laboratory to more valuable uses. A satisfactory label can be made of pieces of opal glass of a suitable size and thickness. Opal glass sheets or slips can be obtained easily commercially with one side polished and the other rough and unpolished. There is no difficulty in writing with a graphite pencil on the unpolished surface, and the writing is permanent in ordinary preservatives and fixatives.

In overlooking recently a quantity of labels I made in this way in 1912 and 1913, I find they are as clear to-day as when written. I have also used labels of this kind during many years for experiments in the sea, but growths may render them undecipherable after about a year's immersion. No doubt other workers have used similar labels, but if so, the fact merely serves to show that convergence is common in the realm of ideas as it is in organic evolution.

J. H. ORTON.

Marine Biological Laboratory,
Plymouth,
June 15.

The Reflecting Power and Colour Sequences shown by Metals on Activation.

THE brightening of the colour sequences shown by copper on continued oxidation and reduction has been observed to occur simultaneously with the increase in catalytic activity (cf. Hinshelwood, *Proc. Roy. Soc.*, A, vol. 102, p. 318; 1923). Direct spectrophotometric observations have shown (*Proc. Roy. Soc.*, A, vol. 117, p. 377; 1928) that the reflecting power of the metals, iron, nickel, and copper reduced from the granular oxide increases with the number of oxidations and reductions until a limiting reflecting power is reached, and that the brightening of the colour sequence is a consequence of the increased reflecting power of the underlying metal. The limiting reflecting power of activated reduced nickel and copper is, however, much less than that of the burnished metals. Thus a burnished metal surface becomes duller on activation, and the accompanying colour phenomena are less pronounced. This has now been verified experimentally.

It is usual for a metal to produce colour sequences on oxidation which increase in brightness on alternate oxidation and reduction, because the original metallic surface reduced from the coarsely granular oxide becomes finer in structure, but this brightening is not always associated with activation.

A burnished surface becomes duller and coarser on alternate oxidation and reduction, and the associated colour sequences become less bright.

F. HURN CONSTABLE.

St. John's College,
Cambridge.

The Freshwater Medusa *Limnocodium sowerbyi* in the Royal Botanic Society's Gardens, Regent's Park.

IT may be of interest to record the reappearance of the freshwater jellyfish, *Limnocodium* (*Craspedacusta*) *sowerbyi*, in the *Victoria Regia* tank of the Royal Botanic Society's Gardens, Regent's Park. The medusæ were found by us in large numbers on June 30, and some persisted over the week-end. The specimens are mostly fully grown, with an umbrella diameter up to about 13 mm. They resemble in every way the specimens first described by Allman and Lankester. These remarkable freshwater medusæ were first discovered in Regent's Park in 1880, and are reported to have reappeared there for four or five years; they have apparently not been noticed in the tank in recent years. Since its original discovery in 1880, the jellyfish has, however, been recorded from tanks in botanical gardens in other towns in England, in France, Germany, and the United States.

The most recent appearance of *Limnocodium* in England that we can trace, was in the *Victoria Regia* tank in the Botanical Gardens in Birmingham, where they were collected by Prof. Boulenger in 1912. Apparently the same species was found by Prof. Carman in a creek near Frankfort, Kentucky, in 1916, whilst an allied species, *L. kawaii*, has been recorded from a river in China.

W. U. FLOWER.
S. LOCKYER.

Bedford College,
London, N.W.1,
July 2.

The Complementary Nature of the Quantum Theory.

PROF. BOHR has kindly informed me that in the last chapter of my recently published book on quantum mechanics, the reference to his work on the complementary nature of the quantum theory (described in the supplement to NATURE of April 14, pp. 579-590) may perhaps give rise to misunderstanding. When I was last in Copenhagen, in September of the past year, Prof. Bohr was away at the congress in Como, and the views which had been recently developed by Heisenberg and himself were elucidated to me at the Institute for the purpose of this last chapter. In the discussions, use was frequently made of a mode of probability calculation similar to that used in earlier work on the statistical formulation of quantum mechanics, but which appeared to me to be more simple and direct. Prof. Bohr points out that the wording of the chapter may create the impression that these calculations were *primarily* developed in connexion with the new ideas, whereas they may be said to be characteristic of the whole recent development of the quantum theory. When Prof. Bohr was in Cambridge in November, I happened to have neither the manuscript (then in the press) nor the proof of this chapter (then not yet printed), otherwise this impression would doubtless have been noticed and removed.

G. BIRTWISTLE.

Pembroke College,
Cambridge, June 20.

A Tetraploid *Saxifraga* of known Origin.

THE results of genetical studies, completed up to the F_2 generation this year, and of preliminary cytological investigations, enable us to add another to the increasing list of known tetraploids amongst plants. Crossing *Saxifraga rosacea* with *S. granulata*, a small F_1 generation was raised the plants of which were uniform, except that one showed abnormal development of the petals in most of the flowers. The general balance of characters was towards the male parent (*S. granulata*). One of the F_1 plants with normal flowers was selfed and a large F_2 generation (436 individuals) raised. The plants of this generation were remarkably uniform, except that petal abnormalities appeared in a few or majority of flowers in five plants. No trace of segregation towards the distinct habit and flower characters of the two parents could be traced.

Chromosome counts have been made by Mr. R. O. Whyte, of Cambridge, who reports that the F_2 material has 32 chromosomes in the anthers, the number in this generation being double that in its predecessors. The reduction divisions in the F_1 are most irregular and, at present, difficult to interpret completely. A full account of the work is being prepared for publication.

E. M. MARSDEN-JONES.
W. B. TURRILL.

Kew, June 20.

The Colour of the Peacock's 'Eye.'

WITH reference to Lord Rayleigh's observations on the colour of the peacock's 'eye' in NATURE of May 26, it may be of interest to note the remarkable change in the colour of the filamentous groundwork of the train effected by wet: a peacock living in the open appears in rainy weather to have this part of the train copper-red instead of green, though the 'eyes' remain of the usual colour. This observation applies only to the ordinary peacock; the black-winged mutant has a coppery train when dry, while the very distinct Burmese peacock and its hybrid with the common bird generally show much pinkish-red in the train; both of these, by the way, show a large amount of black in the wing. What the trains of peacocks of these three kinds look like when wet I do not know, having observed them chiefly in the Zoological Gardens, where they are kept in aviaries with shelter always available, and so do not get wet.

Ordinary daylight would also appear in some cases to effect a considerable change in the colour of the train of stuffed peafowl, the specimens in the peacock case at the Natural History Museum being abnormally blue, except the bird shown in display, which is a new one. Yet a peacock in the Horniman Museum, exposed to a far stronger light, has kept its normal coloration for years; but it has not been exposed nearly so long.

F. FINN.

Spectrographic Detection of 'Traces.'

IN the May issue of the *Journal of the Chemical Society* Dr. J. A. N. Friend, in a paper entitled "Experiments on Transmutation" (pp. 1321-1324), announces negative results of examinations by spectral means for 'traces' possibly formed in specimens of barium sulphate, silver foil, and gold foil by bombardment from a source of radium-*D*, -*E*, and -*F*, and also by the action of radium emanation.

He states: "If any kind of transmutation had taken place, its quantity was too minute to admit of detection spectroscopically."

It is desirable to point out that as only spark, and not D.C. arc, spectra were used, this statement is open to question: arc spectra are so much more powerful in revealing 'traces' that they should always be employed if possible for this purpose. Further, if spectral examination is contemplated as the final stage of an investigation, the latter should be so planned that arc spectra can be used.

J. R. GREEN.

Batchelor, Robinson and Co., Ltd.,
Llanelly.

The Bicentenary of Joseph Black.

THOUGH the event has apparently passed unnoticed, on April 16 last occurred the bicentenary of the birth of Joseph Black, whose name is rendered immortal by his epoch-making chemical discovery of the nature of 'fixed air,' or carbon dioxide, and by his enunciation of the doctrine of latent heat. These two important additions to knowledge were made by Black in early manhood, but though he lived to the age of seventy years, history records no further contribution to scientific discovery by him, while of all men of science his writings are of the scantiest. His fame, however, was world-wide. His great contemporaries in England were Priestley and Cavendish; in France, Lavoisier, Berthollet, and Fourcroy, and it was the last who once referred to Black as "the Nestor of the chemistry of the eighteenth century." Proust, also on Black's name being mentioned, exclaimed: "Ah! c'est le Patriarche de la Chimie." Of Black's career and work, practically all that will probably be known is contained in "The Life and Letters of Joseph Black, M.D.," the last published work of the late Sir William Ramsay. From a scrap of autobiography given in this we learn that Black was born at Bordeaux on April 16, 1728, his father and mother both being of Scotch descent. He was one of a family of eight boys and five girls, and was taught English by his mother. At the age of twelve years he was sent to school at Belfast. At sixteen he entered the University of Glasgow, at twenty-one he removed to Edinburgh, and in 1754, at the age of twenty-six, took his degree of M.D. with the thesis, "De Humere Acido a Cibis Orto, et Magnesia Alba," which, developed and perfected, was read two years later to the Medical Society of Edinburgh with the title "Experiments upon Magnesia Alba, Quicklime, and other Substances."

At Glasgow, Black had come under the influence of Cullen, who saw that chemistry was not merely a curious and useful art, but a "vast department of the science of nature, which must be founded on principles as immutable as the laws of mechanism, and which may be one day formed into a great system of doctrines, of various degrees of subordination and dependence." Black probably began studying under Cullen in 1749, but his experiments for his thesis were begun in 1752. Black in 1754, in a letter to his father at Edinburgh, said, "Medicine is allowed on all hands to be in a very flourishing condition. It is practised in the most rational and simple manner," but the cause which led to his famous research was a curious one. A medicine invented by a Mrs. Joanna Stephens had apparently relieved both Sir Robert Walpole and his brother, who were troubled with the stone. Through them she received no less than £5000 to reveal the secret, which was published in the *London Gazette* of June 19, 1739. It ran as follows: "My medicines are a Powder, a Decoction, and Pills. The Powder consists of Egg-shells and Snails, both calcined. The decoction is made by boiling some Herbs (together with a Ball, which consists of Soap, Swines'-Cresses, burnt to a Blackness, and Honey) in water. The Pills consist of Snails calcined, Wild Carrot seeds, Burdock seeds, Ashen Keys, Hips and Hawes, all burnt to a Blackness, Soap and Honey." Cullen and his colleagues held opposing views as to such remedies, and it was with the object of discovering a 'milder alkali' that Black began his experiments on magnesia which led to the discovery of 'fixed air.'

After the publication of his thesis, Black practised medicine in Edinburgh for two years, and then, on Cullen's transference to that University, Black succeeded him at Glasgow, where he remained from 1756 until 1766. It was during these years that he enunciated and first taught the doctrine of latent heat, of which he read an account to a society in Glasgow on April 23, 1762. In his lecture notes occur the sentences: "To ascertain what I mean by the word Heat" to "ascertain the real difference between heat and cold" and "to mention some of the attempts which have been made to discover the nature of heat." He argued that heat is the positive thing and not cold, and goes on to say, "But our knowledge of heat is not brought to that state of perfection that might enable us to propose with confidence a theory of heat," but "when we have at last attained it, I presume that the discovery will not be chemical, but mechanical."

One or two of Black's experiments may be recalled. In the first he hung two globes 18 inches apart in a large hall; one contained 5 oz. of water the other 5 oz. of ice. The water in half an hour had increased in temperature from 33° to 40° F., whereas 10½ hours elapsed before the ice had melted and attained the same temperature, from which he argued that 139 or 140 "degrees had been absorbed by the melting ice, and were concealed in the water into which it had changed." He next tried adding equal weights of ice and water at 32° to equal quantities of warm water, and deduced the figure 143° F. In the third experiment he proved that a lump of ice placed in an equal weight of water at 176° F. lowered the temperature to 32°. Somewhat similar experiments were made by Black on the latent heat of steam, in which he compared the time required for a known weight of water to rise through a definite interval of temperature when exposed to a constant supply of heat with that required to dissipate the water into steam, and it was the results of these experiments which Black communicated to Watt just at the time the latter was pondering over the problems raised by the irregular working of the model Newcomen steam engine in the University of Glasgow.

Few scientific discoveries have had a greater influence on the work of engineers than those made in the effects and properties of heat, of which Black's was one of the most important. Up to the seventeenth century all had been conjecture. The first real step in progress was the invention

and improvement of the thermometer. This first appeared in Italy about the same time as the barometer, and the conception of the steam engine may be traced directly to the introduction of those philosophical instruments and the enlargement of human knowledge they brought in their train. Fahrenheit, the German instrument maker of Amsterdam, was the first to make thermometers with adequate skill, and he also fixed, first the freezing point, then the blood heat, thirdly the extreme cold of a mixture of ice, water, and sal-ammoniac, and then the boiling point of water. Writing a hundred years later, Sir John Leslie, himself a great experimenter, said: "The Doctrine of Heat has in the course of the eighteenth century been advanced to the rank of a science. Its transfusion through the mechanical arts has communicated a grand movement to society and wonderfully augmented our natural wealth and resources." Leslie then went on to recall some of the most important discoveries: Fahrenheit's thermometric scale; Cullen's observation of the lowering of the boiling point under a decrease of pressure; Black's theory of latent heat and sensible heat; the introduction of the terms 'capacity for heat' and 'specific heat'; Lavoisier's and Laplace's experiments on calorimetry; Wedgwood's pyrometers; the registering thermometers of Six, and the production of artificial cold; but like Black he felt that the true theory of heat had yet to be discovered, remarking, "What seems wanted at present to complete our knowledge of heat, is not the vague repetition of experiments already carefully performed, but a nice investigation of several unexplored properties, directed with scrupulous accuracy on a large scale." Had Leslie but known it, even at the time he wrote, the famous essay of Carnot had already been published, while Joule, Rankine, Kelvin, Mayer, Clausius, Tyndall, and others were just beginning the careers during which they were to demonstrate by means of "nice investigations," "directed with scrupulous accuracy," that, as suggested by Black, the true theory of heat is not "chemical, but mechanical."

With Black's work on latent heat his course of discovery came to a close. In 1766 he removed to Edinburgh as professor of chemistry, and there for more than thirty years lectured on his favourite subjects. The friend of Watt, Adam Smith, Robison, Hume, Playfair, and Hutton, he passed his life in the quiet performance of his congenial duties, somewhat indifferent to honours, but cheerful and courteous to all alike. His death took place suddenly as he sat in his chair, on Dec. 6, 1799. Robison, who wrote a sketch of him and published his lectures, gave the date of his death as Nov. 10, and Ferguson gave it as Nov. 26, another mistake. It was Muirhead who first pointed out the discrepancy; the date Dec. 6 being confirmed from the newspapers of the time.

Life's Unsuspected Partnerships.[1]

By Prof. DORIS L. MACKINNON.

SYMBIOSIS is the word used by biologists to describe the state of affairs in which two or more different kinds of organisms are closely, and in some cases inseparably, associated for the greater part of their lives in a partnership from which both, in some degree, probably draw benefit. Within the last few years, many unsuspected interdependences have been revealed, and a vast field has been opened up for further research.

It has recently been claimed by Pierantoni and other workers that the luminescence of surface-living cuttle-fishes, pelagic tunicates, and certain reef-inhabiting fishes is produced by bacteria that are in constant symbiosis with them. Saprophytic light-giving bacteria are abundant in the sea, and are inevitably swallowed by feeding animals, in the dead bodies of which they multiply exceedingly, and, still glowing, produce the disconcerting phenomenon of phosphorescence which may be noticed, for example, in rotting fish.

Among the little sand-hoppers of the genus *Talitrus*, which are normally not luminescent, one is occasionally found glowing with a mysterious inward light. Such individuals are always diseased, and if their infected blood be injected into the bodies of other like crustaceans, these also begin to glow and soon die. It would look therefore as though, for some animals, the incursion of luminescent bacteria is directly harmful. But others have acquired immunity against the invaders, and have even turned the invasion to account. Such are the pelagic tunicates and the cuttle-fishes. The best-known example of tunicate phosphorescence is that of the creatures known as *Pyrosoma*, which form transparent, gelatinous, tube-shaped colonies floating on the surface of the warmer seas. The walls of the tube are composed of numerous individuals seated in a common gelatinous envelope and adding to their number by budding. The mouth of each person is directed outwards, and close behind it is a patch of tissue which is the light-organ. It has been discovered that the cells composing this organ contain luminescent bacteria, and it is the glowing of these that gives the animals their phosphorescence. It is not easy to imagine what advantage the *Pyrosoma* colony derives from this; the animals have no eyes, they are hermaphrodite, and they lie in close association; but some important advantage there must be, for the eggs that will give rise to new colonies are always furnished with a certain quantity of the bacteria, handed on from the parent.

When the *Pyrosoma* individual is sexually mature, some of the bacteria in its light-organ begin to form spores, which then leave the shelter of the cells in which they have developed and are carried by the blood-stream to the little sac in which the single egg is developing. Invading the cells of this sac, they seem to induce these to divide, and one of the

[1] From a Friday evening discourse delivered at the Royal Institution on May 11.

daughter cells at each division moves into the space between the sac and the egg. This invasion continues and the infected cells continue to multiply and move in towards the egg until there are about four hundred of them. The egg itself has meanwhile begun to divide, and the infected follicle cells, glowing all the time, take up their position between the blastomeres. Each egg gives rise to four *Pyrosoma* individuals, which will be the founders of a new colony, and between these four the invading luminescent cells are scrupulously divided, taking up their definitive position, as time goes on, in the light-organs. In this way, from generation to generation, the sacred flame is handed on.

In the cuttle-fishes, the eyes are in their way as perfect optical apparatus as those of a vertebrate, the sexes are separate, and in the majority of species the luminescence is shown by the female only. The eggs of the cuttle-fish are enveloped in a shell which is secreted around them on their passage to the exterior by structures known as the nidamental glands. In front of the nidamental glands lies another, usually called the accessory nidamental gland; and it was always supposed that this furnished some contribution to the egg-shell. But now we know that it does no such thing: it is a phosphorescent organ, composed of tubes of three kinds and colours, white, yellow, and orange, each of which is crammed with bacteria of a different sort: it is those in the yellow tubes that are luminescent. The luminescent gland opens to the sea and the bacteria can pass out. The cuttle-fish, then, may glow with a more or less steady internal light, or it may eject streams of fire. In some cuttle-fish, the apparatus is further complicated by the development of a reflector behind the gland, backed by a pigment screen, and there is actually a lens in front, so that the animal has a veritable bull's-eye lantern. The opening of the light-organ is so arranged with relation to the genital duct that the eggs as they pass along get smeared by the expressed bacteria, and so the new generation is safely infected. We find the bacteria glowing inside the egg-shell, though how the embryo actually incorporates them we do not yet know.

The presence of three different kinds of bacteria is paralleled by the condition of things in certain insects. It is known that many bacteria are mutually interdependent, and will not flourish when isolated from their fellows; possibly we have here a second degree of symbiosis within the first. In these cases, then, the light would seem to be the product of captured and tamed bacteria; and we speak of a symbiosis, though we are very far from understanding yet the special advantages that accrue to the microbe partner.

Now, while the symbiosis productive of luminescence may give protective advantages or facilitate mating, the other and far commoner examples with which I propose to deal are concerned with nutrition. The primary concern of all living organisms is with food, the getting of it and the dealing with it when it has been secured; and we cannot even begin to understand the majority of symbiotic partnerships until we know something about the feeding habits of the organisms concerned. In the more intimate associations, as of green plant with fungus or bacteria, of animal and green plant, of animal and fungi and bacteria or protozoa, the microscopic partner has been called in to perform some function that the larger partner cannot perform for itself. Let us bear in mind that the green plant, the fungus, the bacterium, and the animal have each very different capacities of dealing with the material that composes what we call their food.

It must be admitted that, seen from our point of view, many of these associations appear very one-sided in their benefit and border closely on true parasitism, between which and symbiosis there is no hard-and-fast line to be drawn. Strictly speaking, we should use symbiosis to describe a condition where equilibrium is established between the partners, but we still use the term when one organism seems to derive more benefit than the other: true parasitism may be said to occur when the benefiting organism gets the upper hand so far that it lives actively upon its host's tissues or diverts so much of the available food that the host dies of starvation. Obviously, it is seldom to the advantage, even of a parasite, to kill the goose that lays such golden eggs; and where such a thing occurs, we may assume that perfect equilibrium has not yet been achieved. In the course of ages many harmful parasites, as we see them to-day, may become innocuous; and as their hosts develop an immunity, they may even become useful symbiotes.

It is well known that the leaf-cutting ants of the genus *Atta* do not feed directly on the leaves they cut up, but use these as manure for their fungus-gardens, and it is on the white mycelial nodules of the fungus that they depend chiefly for food. The greatest care is taken of the fungus-gardens, and we may say that the same sort of symbiotic relationship exists between the ants and their fungi as between the ants and their green-fly 'cattle.' It has for a long time been a puzzle as to how the precious plant is transferred to the new nest when the young queen leaves the old colony; now it is known that the queen carries with her, in a little pocket under her chin, a sample of the necessary mycelium, and in the new nest she deposits this and cares for it as diligently as for the eggs she lays, until such time as the workers hatch out and are ready to take over these menial duties.

Strange to say, this same habit of fungus-culture is also found in one of the families of termites, and it occurs again among certain beetles, such as *Hylecoetus dermestoides*, the larvæ of which live in tunnels that they make in fresh wood. These larvæ, when they hatch out, feed upon the mycelial nodules, rich in protein, which line their tunnels. It has recently been shown by Buchner, that the adult female *Hylecoetus* has on her ventral side two elongated pockets filled with thick-walled fungal spores, and between these pockets lies a gutter also filled with spores. All these structures end just where the oviduct opens to the exterior, and the eggs as they are laid get smeared with the spores

squeezed out on them by the muscles of the abdomen. The eggs are deposited on the bark of a tree, and the larva, in eating its way out of the egg-shell, devours with that the spores and so gets infected. The larva burrows into the wood, and the spores, passing through its body uninjured, are deposited in the excrement, germinate, and, even in the poor soil of the powdered wood in the tunnel, produce a flourishing supply of rich fungal food.

The wood-wasps of the genus *Sirex* do something of the same kind. Here the infecting apparatus consists of two syringes filled with the oidia of a fungus, and between the syringes is a gland, the sticky secretion from which mingles with the fungal material as it is squeezed out when the eggs are laid. The mycelial growth that appears within the larval tunnels is never so rich as with *Hylecoetus*, and here it may be that the grub merely makes use of the fungus as an aid to the digestion of the gnawed wood, about 50 per cent of which is pure cellulose.

Cellulose does not occur in animal tissues, if we except the group of the tunicates, and there are very few animals that produce enzymes capable of splitting it up and putting it in a more assimilable condition. So far as we know, no vertebrate can digest cellulose unaided, and among the invertebrates the only established examples are those of certain snails, the shipworm, the crayfish, the earwig, and a butterfly. Innumerable insects live on vegetable matter containing a high percentage of this indigestible material; although they seem able to make use of it, they secrete no cellulose-splitting enzyme that we can discover. The suggestion is that they call in the aid of fungi and bacteria that have this peculiar power. We assume, then, that the fungus-gardens of the ants and termites and of other insects with wood-eating larvæ, furnish not only direct nutriment but also substances that will split up the cellulose for the animals that ingest these.

From the external fungus-garden in the nest or the burrow, it is only a step to an internal symbiosis. Why not carry one's garden around with one all the time ?

We find, in fact, that the majority of insects living on plant tissues or plant juices have outgrowths from the gut in which swarms of yeasts or of bacteria have their permanent abode. Sometimes, as in *Dacus oleæ*, the olive-fly, the symbiotes live free in the cavity of the reservoir. More often, perhaps, they are contained within the cells of which it is composed. How the micro-organisms are prevented from multiplying to excess we do not know ; but that is what we should expect in a true symbiosis—that the host should have developed some power to keep its guests in useful check.

Here, as in *Hylecoetus* and *Sirex*, we find the most elaborate precautions for ensuring that the next generation shall be furnished with the necessary supply of the symbiote of the species. When the female insect is sexually mature, numbers of the bacteria or of the yeasts migrate to the hinder end of its body and take up their position in outgrowths from the gut opening just by the aperture from the oviducts. The yeasts are squeezed out on the shells of the passing eggs, and are presumably swallowed by the larvæ as they emerge ; the still smaller bacteria frequently pass through the micropyle of the egg or through tiny pores alongside this, and the emerging larva is already safely infected.

It has also been observed that blood-sucking invertebrates habitually harbour micro-organisms, which may possibly help them to digest blood. Lice, bed-bugs, tsetse flies, culicine mosquitoes and leeches all have in their guts micro-organisms comparable with those we meet with in insects depending on a plant diet rich in cellulose. In some instances here also the transfer of the symbiote to the young of the host has been demonstrated.

It is not only in connexion with luminescence or with their immediate digestive activities that animals have called in the aid of symbiotes. Certain snails of the families Cyclostomatiidæ and Annulariidæ have long been known to have curious branched, concretion-containing 'glands' lying on the dorsal side of the intestine and in close proximity to the kidney. The concretions are spherical in form and are composed mainly of uric acid deposited in an organic matrix arranged in concentric lamellæ. They lie in special cells known as purinocytes, and alongside them within these cells there are almost always quantities of a bacillus. The purinocytes are undoubtedly excretory in function. The work of Meyer and others has shown that they remove from the snail's tissues and store the excess of nitrogenous waste in the form of the concretions. Then, according to Meyer, the bacilli invade the purinocytes and do their work, which seems to be the breaking up of the uric acid.

The tissues of the snail itself do not produce any uriolytic ferment, and the animal seems to depend on bacterial assistance at this point. A number of free-living bacteria are known to have this power of splitting up uric acid, and in the soil, among the decaying leaves on which the snail feeds, are found bacteria indistinguishable from those in its purinocytes. They also occur in the snail's gut, where they have come with the ingested food, and there seems every reason to suppose that they make their way thence to the excretory cells—though why they should show this special affinity for the purinocytes remains a mystery. (The same might be said of the yeasts in the 'mycetomes' of insects.) Presently certain cells in the neighbourhood of the purinocytes become actively amœboid and devour the purinocytes with their contents—the organic basis of the partially dissolved concretions, that is, *and* the bacterial symbiotes whose work is now over. Presumably the phagocytic cells then hand over to the snail's tissues the broken-down products, and presumably these are anabolised by the mollusc, especially during the periods of inertness which we call hibernation.

I say 'presumably.' It will be noticed that in nearly all these recently investigated examples of suspected symbiosis, we must still qualify our

assertion. The inference is strong that the micro-organism is a true symbiote—its constant presence in the special situations, its unvarying character, its scrupulous distribution to the offspring, its powers of producing chemical changes of which the host is known to be incapable, but can, in its presence, effect. There is much circumstantial evidence. But we cannot say with certainty that the partnership exists, in however one-sided a degree, until we have proved by experiment that the containing animal suffers irreparably through removal of the guest, and is benefited by its return.

An experiment of this kind has been undertaken and carried through with success in the case of certain wood-eating termites. Some termites habitually cultivate fungus-gardens, and such species live on rotting wood and other vegetable matter plus the assisting fungus. The true wood-eating termites, and these form the majority of families, cut up and eat wood that is quite fresh; and termites of these families do not cultivate fungus-gardens. The wood on which they depend for subsistence contains at least 50 per cent cellulose, and the experiments of Cleveland have proved that such termites, kept in the laboratory, can live for at least three years—perhaps indefinitely—on a diet of pure cellulose. In these experiments of Cleveland's, the cellulose was given in the form either of pure filter-paper or of specially prepared ligno-cellulose.

The cellulose-fed termites in the laboratory behaved in exactly the same way, and flourished just as well as the controls living on a more normal-seeming wood diet. That is to say, the workers always fed directly on the pabulum, and so did the nymphs of all the other castes. The royal forms likewise fed themselves until the so-called post-adult stages, when they, together with the second and third form adults and the adult soldiers, became dependent on the workers for food-supply, the muscles of their own jaws atrophying, or, in the case of the soldiers, the mandibles becoming so large and unwieldy as to be useless for wood-gnawing. The dependent castes fed either on the semi-digested food passed from the hind-gut of the workers, or on the secretions poured out from their salivary glands. It was the soldiers who seemed to live most constantly on the semi-digested gut-contents of the workers; the younger creatures—the nymphs and the royal and complementary forms in their later life depended on the salivary secretions.

Now cellulose is indigestible even by termites, which secrete no cellulose-splitting enzymes; and these families have not even got fungus to aid them. But it has been known for a long time that the gut of the true wood-eating termite that does not cultivate fungus, harbours an extraordinary menagerie of protozoa not found anywhere else, if we except some small relatives from the hind-gut of the cockroach. Unless it has been seen, the writhing multitude of inter-sliding protozoan bodies that almost blocks the gut of a healthy termite worker and constitutes about half its total body-weight, is difficult to picture. In spite of their relatively large size and the vast numbers of motile threads covering their bodies, they are ranked by protozoologists among the flagellates, where they form a special and peculiar group, the Hypermastigina or trichonymphids. It seems that each genus of wood-eating termites has its own special association of trichonymphids. Now it is to be noted that the flagellates are found abundantly in all the castes at the stages when they do their own feeding. They disappear from the second and third forms in later life, and become less abundant in the soldiers after these have passed the nymph stage. Larvæ isolated from the time of hatching never have any; but if they are placed with workers, they have protozoa in their guts within twenty-four hours. The soft protoplasmic bodies of the flagellates are generally crammed with tiny fragments of termite-masticated wood which they have picked up: they have no mouths, but probably take in the particles at the naked posterior end of the body.

It has long been suspected by protozoologists and by entomologists that these strange flagellates are not parasites of the termite, nor even mere commensals, but true symbiotes in the highest degree, conferring incalculable benefits on their hosts, and, richly compensated in return by food and shelter, become incapable of living a separate existence. It has been suspected that these protozoa, like certain fungi and bacteria, have the power of splitting up cellulose, living on the more assimilable products and handing over to their hosts a certain proportion thereof, adequate not only for the particular individuals they inhabit, but also for the dependent castes.

Cleveland's ingenious experiments have recently carried these suppositions into the realm of scientific fact. First he set about removing the protozoa from their termites without injury to the insects. This was difficult. He did it in three different ways—by starvation, by keeping the colonies at a temperature of 36° C., and thirdly, by subjecting them to oxygen under pressure. The first method, starvation, removes nearly all the protozoa in about fifteen days, but it is impossible to defaunate the insects completely before they themselves have begun to suffer in health. Incubation at 36° C. for twenty-four hours kills the protozoa without damaging more than a small percentage of their hosts. But an oxygen pressure of four atmospheres kills the flagellates in about half an hour without damaging their hosts at all, and this method has been found the most convenient for experiment. The various kinds of trichonymphids in one termite gut are variously susceptible to the effects of the poison. By varying the dose and the period over which it acts, Cleveland has found it possible to remove first one species and then another, thus altering the character of the particular intestinal fauna in which direction he will, for when one species dies out another there present multiplies rapidly and takes its place.

The termites defaunated by the oxygen poison are themselves perfectly healthy, but when they are supplied with wood to feed on, though they devour it greedily, they cannot digest it, and they

die of starvation in three to four weeks. Supply them, however, with predigested humus or with fungus-digested cellulose, and they can get on all right. But the crucial test is yet to come. Put them back with other termites of their own kind containing protozoa, they rapidly become re-infected, are then once more able to cope even with pure cellulose, and can live on that indefinitely. There seems, then, no question whatever that the protozoa split up the cellulose for them, and that, in the course of ages, they have become absolutely dependent on these secret sharers for their essential food. The flagellates, for their part, cannot live for more than ten days apart from their termites, and then only in a special blood-serum medium to which finely powdered ligno-cellulose is added. They have never been known to form protective cysts, and, so far as is known, they do not occur anywhere else in Nature. The exact method by which they are transferred from termite to termite is not fully understood—though probably they pass in the semi-fluid substance from the anus of the workers.

The association between these partners is undoubtedly of very long standing—it must have taken many ages to evolve the exact adjustment between them and the extraordinary specialisation that we find. But complete and successful the partnership undoubtedly is. Many minor details have yet to be worked out. We do not yet know in what form the broken-up cellulose is handed on to the insect. A great deal of glycogen (animal starch) is always found in the bodies of the trichonymphids, though none occurs in the intestinal cells of the termite. Even when the diet has been pure cellulose for as much as three months, the protozoa still contain glycogen. The suggestion is that they split the cellulose into the sugar glucose, which they then build up into glycogen. How they hand over the excess to their partners we do not know, or whether, as seems possible, their own bodies are sacrificed in the process. Nor do we know yet how the termite gets the nitrogen necessary for the formation of protein when it is fed on pure cellulose. Possibly the bodies of the junior partners afford the immediate supply: but whence have *they* got their nitrogen? Have they the power of fixing free nitrogen, as certain bacteria have? Or do the termites themselves perform this un-animal-like feat? Do not let us forget, however, that along with the flagellates in the termite's gut there are also myriads of other micro-organisms—spirochætes, bacilli, and what not. It may be that these are, in their degree, essential partners in the process.

Obituary.

SIR JOHN ISAAC THORNYCROFT, F.R.S.

SIR JOHN ISAAC THORNYCROFT, whose death on June 28 we much regret to announce, was born on Feb. 1, 1843, at Rome. He was eldest son of Thomas Thornycroft, a sculptor, who had married Mary, the daughter of John Francis, who had taught him his art. Sir William Hamo Thornycroft, the sculptor, was another son of Thomas Thornycroft. Educated first at private schools, Sir John Thornycroft became a student of the University of Glasgow, and there came under the influence of Rankine and Kelvin. After gaining some experience in shops in the north of England, in 1866, the same year that Sir Alfred Yarrow started at Poplar, he began boat building at Chiswick, and soon became known for his success with steam-boat machinery. The little *Miranda*, built in 1871, was only 45½ feet long, but created considerable stir by steaming at 16¼ knots.

It was the adoption of the spar torpedo, and then the automobile torpedo for naval warfare, that opened a new field to Thornycroft, and in 1873 he constructed his first torpedo-boat for the Norwegian government. In 1877 he built H.M.S. *Lightning* for the Royal Navy. He was probably the first to use a locomotive boiler in a boat, and when this type of boiler proved troublesome, he invented a water-tube boiler. He early employed forced draught in his boats, and was a pioneer in the construction of fast-running, lightly constructed steam engines. His first vessel fitted with a water-tube boiler was the mission boat *Peace*, for use on the Congo. In the two torpedo-boats for the British Navy, Nos. 99 and 100, he introduced the flat stern and the double rudders which became a conspicuous feature of his designs. The history of the torpedo-boat destroyer begins with the *Havock* and *Hornet*, ordered by the Admiralty from Yarrow, and the *Daring* and the *Decoy*, ordered from Thornycroft. The *Hornet*, with Yarrow boilers, attained a speed of 27·3 knots, and was the fastest craft afloat. She was soon beaten, however, by Thornycroft's *Daring*, which attained a speed of 27·9 knots. Both these records were surpassed by the Russian *Sokol*, built by Yarrow in 1895, and by the *Forban*, built by Normand the same year, which did 31 knots. Reciprocating engines were used in this type of craft up to 1906, and Thornycroft built and engined many of the so-called thirty-knotters. On the adoption of the Parsons' steam turbine he was given the contract for some of the coastal destroyers, and in 1907 built and engined the ocean-going destroyer H.M.S. *Tartar*, which with oil fuel and triple screws driven by turbine attained a speed of 35·6 knots.

Thornycroft had been joined by the late John Donaldson in 1872, and later on by the late S. W. Barnaby, while for many years Mr. C. H. Wingfield was the chief mechanical engineer of the firm. Motor building had been added to the firm's activities in 1896, and after Donaldson's death in 1899 the concern was turned into a company. In 1906 the work having outgrown the capacity of the premises at Chiswick, a site was secured at Woolston, near Southampton, and it was there that all the later destroyers were built. During the War the firm built and engined twenty-nine torpedo-boat destroyers and flotilla leaders, with a total tonnage of 37,210 tons and 957,000 horse-

power, besides some submarines and other vessels. Mention should also be made of the remarkable coastal motor boats which were used with success off the Belgian coast and in the attack of Cronstadt.

A frequent contributor to the *Transactions of the Institution of Naval Architects* and other technical societies, Sir John Thornycroft was elected a fellow of the Royal Society in 1893, and in 1902 received the honour of knighthood. For some years past he has resided at Bembridge, in the Isle of Wight, engaged in the study of the problems in naval architecture to which he has made so many notable contributions. He married in 1870, and had two sons and five daughters. His eldest son, Sir John Edward Thornycroft, the present managing director of the firm, was knighted in 1918.

A DISTINGUISHED naval architect has favoured us with the following appreciation of Sir John Isaac Thornycroft:

Sir John got most of his early technical training from his father, who was a keen amateur engineer with a sound knowledge of mechanical principles. Sir John spent some time at South Kensington and was a contemporary there of Sir Philip Watts. Unlike some of his famous contemporaries, he did not serve an ordinary apprenticeship. He was at the University of Glasgow in the engineering class under Prof. Rankine, and took the natural philosophy class under Lord Kelvin. The class of naval architecture and marine engineering was not then founded, but Prof. Rankine's lectures included much that was the foundation of the science of marine engineering, and young Thornycroft no doubt owed a great deal of his scientific knowledge to the lectures of Prof. Rankine.

Like his co-worker in the development of small high-speed vessels, Sir Alfred Yarrow, Thornycroft began to make high-speed vessels when scarcely out of his teens. He produced the *Miranda*, which attracted the attention of the Admiralty; he built for the Norwegian Government in 1873 a 14-knot boat. Other governments ordered vessels of 18 knots, and the British Government ordered from him in 1878 the first torpedo-boat built for the Navy, the *Lightning*, of 80 ft. length and 18 knots speed. He built this vessel in a small yard on the Thames at Chiswick, and there built many other torpedo-boats, and ultimately the *Speedy* in 1893, which was almost too large for the capacity of the works. Later, the development of the torpedo-boat destroyer, which gradually grew to be too large for the scope of the Chiswick works, caused the acquisition of the present Thornycroft yard at Southampton early in this century, where the traditions of the firm are maintained and where the latest destroyer for the British Navy still holds the high record which has been continuously maintained since Sir John I. Thornycroft first created it in his almost boyhood days.

Thornycroft's early work was associated with the locomotive boiler in ships, but the pressure for higher speed led him to develop the Thornycroft water-tube boiler, which is to-day the steam producer in all the destroyers built by his firm. He devoted himself also to high speed in smaller vessels, and developed the form of small high-speed vessel known as the 'hydroplane,' which by a series of two or more inclined planes in the form of the bottom of the vessel forces her out of the water, and so reduces the resistance and increases the speed. This principle was of great value in the War, and was applied by Thornycrofts in the building of 40-knot coastal motor boats which carried torpedoes and attacked successfully larger ships which their speed enabled them to evade.

Sir John I. Thornycroft had for many years given up the commercial management of the Thornycroft business, and had left it to his son, Sir John E. Thornycroft, devoting himself to the technical and scientific side of ship design and research. He will be remembered as one of the three pioneers in light high-speed vessels and machinery of the last half of the nineteenth century; of the other two, Normand has passed away, but Yarrow is with us still. Sir John I. Thornycroft himself appeared less in the public eye than the other two, preferring the rôle of the scientific worker to that of the commercial man, but his work for his time did not suffer thereby. He was taking a keen interest in engineering and scientific matters to the end.

PROF. LAUNCELOT HARRISON.

THROUGH the untimely and unexpected death of Prof. Launcelot Harrison on Feb. 20 last, at the early age of forty-eight years, Australian zoology has lost one of its most distinguished exponents, and the University of Sydney a brilliant and stimulating teacher, who had made his influence felt both inside and outside the university walls.

Harrison was born at Wellington, N.S.W., in 1880, and was educated at the King's School, Paramatta. Taking up a business career, it was not until 1911 that he found it possible to enter the University of Sydney as a science student. He was already imbued with that profound love of natural history which had been fostered by years of active membership of the Field Naturalist Club and remained with him to the end. After a distinguished undergraduate career, he took the B.Sc. degree in 1913 with first class honours and the University medal in zoology. In the following year he was awarded the John Coutts and the 1851 Exhibition Scholarships and proceeded to Cambridge, where he gained a research exhibition at Emmanuel College and the B.A. degree by research in 1916. In the same year he was selected as advisory entomologist to the Mesopotamian Expeditionary Force with the rank of lieutenant and later of captain, a position he was thoroughly well qualified to fill through his work in Prof. Nuttall's laboratory and by his own investigations on ectoparasitic insects. He did splendid work in the field, but unfortunately he himself fell a victim to both typhus and malaria, and he never fully recovered from their effects.

At the end of the War, Harrison returned to Sydney to the post of lecturer in zoology, and on the death of Prof. S. J. Johnston in 1920, became acting professor, and two years later succeeded to the Challis chair, so long occupied by his distinguished teacher, the late Prof. W. A. Haswell. At the time of his death he was president of the Linnean Society of New South Wales and a member of the Board of Trustees of the Australian Museum, in the affairs of both of which he took a very active interest.

Harrison's scientific work covers a wide field and is of great general interest. As an undergraduate he had already in 1911 read a paper before the Science Society on "The Taxonomic Value of Certain Parasites," in which he discussed the possible value of the parasites in question (the biting lice or Mallophaga which occur on birds and mammals) in the determination of the phylogenetic relationships of their hosts. This same thesis had been put forward by Kellogg in 1896, also in the case of the Mallophaga of birds, and by Zschokke when dealing with the cestodes of South American and Australian marsupials. It formed the mainspring of Harrison's best work, and he selected it under the title of "Host and Parasite" as the subject of his presidential address to the Linnean Society of New South Wales. This address, which he was destined not to deliver, is a most interesting and masterly survey of the whole field of host-parasite relations, in which his own observations (embodied in a series of scattered papers), as well as those of others, are summarised and discussed. His general conclusion is that parasites may quite justifiably be used to aid in the solution of phylogenetic and other problems affecting their hosts. The address (*Proc. Linn. Soc. N.S.W.*, vol. 53, part I.) is worthy the attention of all zoologists.

As the direct outcome of his work in this field, Harrison became keenly interested in the problems of geographical distribution, and in a series of papers dealing with the migration route of the Australian marsupials and the composition and origins of the Australian fauna, he supported the Antarctic radiation theory and contended that Wegener's hypothesis of the origin of continents is the only one which provides a satisfactory explanation of the facts of distribution (Pres. Address, Sect. D, A.A.A.Sci., Perth, 1926). In 1925, with Miss Claire Weekes, he gave an interesting account of the placentation of the lizard, *Lygosoma entrecasteauxi*, a field of investigation which is being worked by Miss Weekes with conspicuous success.

At the time of his death, Harrison had much unpublished work on hand, notably a taxonomic study of the Ischnoceran Mallophaga and a revision of the Australian frogs, and he had begun the study of a rich collection of developmental material of Ornithorhynchus, procured for the Department of Zoology at Sydney by Mr. Harry Burrell. We venture to express the hope that steps will be taken to ensure that his observations on this priceless material are completed for publication, with adequate illustrations.

Harrison was a man of distinctive and vigorous personality, wide in his outlook and interests. He had the capacity of inspiring his students with the research spirit, and not the least of his services to Australian zoology was his establishment of a vigorous research school in Sydney. Though often incapacitated by attacks of acute arthritis, he carried on his work with cheerful fortitude to the end, which came quite suddenly as the result of cerebral hæmorrhage. We tender our sympathy to his widow (Amy E. Mack), who shared so largely in his interests and in his life's work. J. P. H.

News and Views.

THE past week has witnessed the three-hundredth anniversary of the birth, on July 12, 1628, of Henry Howard, who, in 1677, became sixth Duke of Norfolk, on the death of his brother Thomas. The Royal Society recalls him as the donor of a great library of rare books and manuscripts; the University of Oxford for the bestowal of the Arundel marbles. Originally the library was at Arundel House, in the Strand; afterwards at Gresham College. Howard was elected a fellow of the Royal Society on Nov. 28, 1666, through his acquaintance with John Evelyn. Many important influences were in fact established by means of the friendship. Evelyn himself tells us that it was at his instigation that Mr. Howard granted the Society use of rooms in Arundel House, whilst Pepys writes, under date Jan. 9, 1667, "To Arundel House, when first the Royal Society meet by the favour of Mr. Henry Howard, who was there. And here was a great meeting of worthy noble persons; but my Lord Brouncker, who pretended to make a congratulatory speech upon their coming hither, and great thanks to Mr. Howard, did do it in the worst manner in the world."

HOWARD had travelled much before the Restoration, and in the year 1645 had met Evelyn at Venice. Finally, in 1655, he settled at Albury, Surrey, a home at which the diarist was a frequent visitor. In 1662—the year of incorporation of the Royal Society—Howard's first wife died, and for long he was subject to melancholia, and given to dissipation. The strictures of Evelyn as to Howard's neglect of notable and choice inherited possessions were doubtless well deserved, but in kindly extenuation we suggest that this indifference was the reflex of his unhappy moods and habits. In 1664, Howard left London for Constantinople. An entertaining account of his doings was published by one, John Burbury, in 1671, entitled "A Relation of a Journey of Lord Henry Howard (afterwards Duke of Norfolk) from London to Vienna, and thence to Constantinople," 12mo. In 1669, Howard went as ambassador-extraordinary to Morocco. In 1677, the year previous to a second marriage, he succeeded his brother Thomas as the sixth Duke of Norfolk. He died on Jan. 11, 1684, and was buried at Arundel. There is a portrait of Henry Howard, by Sir Peter Lely, in the National

Portrait Gallery, and an engraving from this portrait is also in existence.

DURING the past thirty years the centre of interest in zoology has moved from classical morphology to those studies concerned with function which are carried out on living animals. Experimental morphology, genetics and the cytological studies which are linked up with it, animal behaviour and the very varied investigations which may be called comparative physiology, now form the great bulk of the zoological work of the world. These investigations have to be carried out under controlled conditions, maintained by methods which have to a considerable extent been discovered by physiologists. The interpretation of their results demands a wide knowledge of other sciences; both physics and bio-chemistry are constantly involved, physiological conceptions form the foundation of many lines of research, and psychology and neurology have the most intimate association with the study of animal behaviour. Thus a modern zoological institute must make provision for keeping animals alive, in good health and under controlled conditions. Its staff must include men who have very varied interests and a familiarity with the methods and ideas of many other sciences. Its work will be made much easier if it be housed in the closest association with active schools of chemistry, physiology, anatomy, and psychology, so that first-hand information about these sciences is always available.

THE conditional gift of £120,000 to University College, London, which has recently been announced, is intended to enable that institution to carry out a scheme for the establishment and endowment of a modern department of zoology, comparable in size with the existing departments of physiology and anatomy. It is intended to erect a suitable new building directly continuing that in which anatomy is housed and to provide the necessary equipment. The staff of the department of zoology will be enlarged by the addition of professors of genetics and comparative physiology, and readers in cytology and animal behaviour, and full provision will be made for the necessary technicians and for the heavy expenses of modern zoological work.

THE attempts to rescue the Italian airmen stranded by the wreck of the *Italia* off North-East Land, Spitsbergen, continue, and search is also being made for the lost French aeroplane with Captain Amundsen on board. General Nobile, who was rescued by aeroplane from the pack-ice, has made a statement, published in the *Times*, about the probable cause of the disaster. Although he had a suspicion that one of the valves in the stern of the airship was leaking, he thinks that the wreck was due to a tear in the envelope. After the *Italia* struck the ice and several of the crew and a considerable weight of material were thrown out, it rose rapidly and disappeared among the clouds to the south-east. General Nobile does not think that the *Italia* could have remained in the air more than an hour longer or travelled more than twelve to eighteen miles. This indicates the area that should be searched for the missing men. Twenty minutes after the accident a column of dense black smoke was seen by several of the crew on the horizon to the east. If this was the burning airship, there is no hope for the men on board. It may, however, have been caused by burning oil and petrol if the tanks had been thrown overboard in order to act as a brake on the fall of the ship. General Nobile inclines to this view, and hopes that the wreck of the vessel may still be found with the men alive; but the hope is faint.

A BRIEF account is given in the *Times* of July 2 of the *Palio* festival held at Siena on the preceding day. This year the procession was particularly splendid. New 'properties' had been provided. Representatives of the seventeen streets marched in procession, on this occasion for the first time with representatives of the old military companies which existed before the fall of the old Republic. A new ox-drawn cart took the place of the old *carroccio*. It was decorated with allegorical banners, and bore the old standard of the commune and four biccharina, the magistrates who once presided over all festivals. Horses representing ten out of the seventeen streets competed for the silken banner and silver plate. The Sienese *Palio* is one of the best known of the summer processions of the Italian towns. The *Palio* from which it takes its name is a canopy which used to be presented by one of the lords of the town as the civil contribution, just as the *Ceri*, huge poles of wood, wax, or other material, to which a phallic origin has been attributed, were the contribution of the ecclesiastical authority. The *Palio* is thought to be the cloth with which the image of the god was covered when it was carried in procession around the commune in the pagan ceremony from which these processions are descended. The *Carroccio*, which is always the principal feature, was in early times the holy war chariot of the community, which, after being blessed by the Church, always headed the warlike expeditions of the State. It is usually regarded as a survival of the cart in which the Aryan-speaking peoples, we are told, carried their gods. It is not without significance that dolls were sometimes attached to the cardboard *Ceri* of Florence.

THE annual special issue of *The Chemist and Druggist*, published on June 30, contains, in addition to its usual items, a number of interesting articles relating to the history of medicine and pharmacology. Dr. Charles Singer contributes a paper on Celtic and Anglo-Saxon medicine and pharmaceutical practice from the ninth to the thirteenth centuries, in which he gives an account of the ancient leech books, sympathetic magic, and Anglo-Saxon medicine, including plant lore. Among the numerous excellent illustrations accompanying the article, special attention may be directed to two beautiful coloured plates, one showing the debt of Anglo-Saxon medicine to the classics and portraying Cheiron the Centaur receiving the Book of Wisdom for Plato in Saxon costume, and the other representing pharmaceutical processes in a MS. of the early thirteenth century. A short paper

by Mr. Howard Bayles on an Elizabethan chemist is illustrated by a transcript of the earliest known reference to a chemist in business contained in a letter dated 1596, by John Delabere, an Oxford physician. Mention may also be made of anonymous papers on Raleigh's chemical and galenical experiments with facsimiles of the recipes prepared by him during his imprisonment in the Tower of London, a sketch of the history and development of the drug trade in London from the time of the Roman Empire until the present day, accompanied by numerous contemporary prints, and notes on the history of Cheltenham, which is to be the seat of the British Pharmaceutical Conference on July 23.

THE Mexican earthquake of June 16, which all reports describe as very severe (NATURE, June 23, p. 994), originated, according to the U.S. Coast and Geodetic Survey, in a centre in 14° N. lat., 95·5° W. long. (*Daily Science News Bulletin*, No. 378 A, Science Service, Washington, D.C.). This point lies in the Pacific Ocean, about 125 miles south of the coast of the State of Oaxaca, not far from the isthmus of Tehuantepec, in which great damage is said to have occurred, and 460 miles from the city of Mexico, where some poorly built houses were injured. The Survey also reports a severe earthquake on Mar. 22 in a centre not far from the above, and two other shocks in the same region on April 13 and 17. One of the latter broke open a tomb in the city of Monte Alban, near Oaxaca, revealing valuable jewels, which it is believed will throw light on the prehistoric races of the country.

THE Nederlandsche Chemische Vereeniging is celebrating the twenty-fifth anniversary of its foundation on July 15–17, and we offer the Society our hearty congratulations and good wishes for a successful meeting. The festivities will take place at The Hague immediately before the meeting of the International Union of Pure and Applied Chemistry. The president of the Nederlandsche Chemische Vereeniging is Prof. S. C. J. Olivier (Wageningen), and the honorary secretary is Dr. A. D. Donk (Haarlem). Honorary membership is to be conferred at the anniversary meeting on several foreign chemists, including Prof. F. G. Donnan, professor of general chemistry in the University of London. It will be remembered that the activities of this important association include the publication of two valuable chemical journals, the *Chemisch Weekblad* and the *Recueil des Travaux chimiques des Pays-Bas*.

AN expedition to the Labrador coast and Davis Strait in connexion with the Ice Patrol of the U.S. Coast Guard is announced in a recent *Daily News Bulletin*, issued by Science Service of Washington, D.C. The steamer *Marion*, under Lieut.-Com. E. H. Smith, U.S.N., will carry this oceanographical expedition, which will be principally concerned with studying currents, in the hope of throwing more light on the drift of icebergs. It is also announced that the Danish Government steamer *Godthaab*, in command of Com. Riis-Cartenson, will be conducting oceanographical work this summer in West Greenland waters.

A MELANCHOLY interest attaches to the paper "On Some Biological Principles" (*Kgl. Danske Vidensk. Selskab.*, Biol. Meddel., 7, 2; Copenhagen, 1928) by Dr. C. G. Joh. Petersen; it was his last work, and marks the end of a long and distinguished career. Since retiring a year or two ago from the directorship of the Danish Biological Station and from active participation in the fishery researches in which he was an acknowledged pioneer and master, Dr. Petersen paid close attention to the philosophical side of biology, and worked out for his own satisfaction a viewpoint which for the time being he felt to be adequate. This point of view is stated in his paper with that simplicity, clarity, and directness which was so characteristic of the man. Dr. Petersen was greatly impressed by the philosophy of Huxley: he held that the mechanistic method should be pushed as far as it would go, and that, as a method, it was more strictly 'scientific' than any other. He recognised, however, that it had severe limitations, and he urged that it must be supplemented by the 'principle of the whole,' which he understood much in the sense established by Kant. This principle could not, he considered, be used for explanation, but only for description and orientation. He held, nevertheless, that it was of great importance and wide application in descriptive biology. He admitted also a third point of view—the psychological—but considered this applicable only to the study of the behaviour of the higher animals, and even there to be used with caution. His paper is one which should be read by all who are interested in the question of biological method. It is the adventure in philosophy of a biologist of long experience and great breadth of view.

AN international illustrated fertiliser review, under the title *Superphosphate*, is being issued by the Superphosphate Manufacturers' Association as a monthly journal. Hitherto the Association's publications have not been available to the general public, its object having been to convey information to its members only. The present aim, however, is to provide a journal by means of which all agricultural scientific workers and practitioners may become acquainted with the work carried out at the Hamburg-Horn Experimental Station, and further to quote the more important information with regard to the utilisation of superphosphate and compound fertilisers from the official reports of the various chemical agricultural research stations of the world. In the first number, a detailed account is given of the comparative pot experiments carried out at Hamburg-Horn with superphosphate and various compound phosphatic fertilisers, barley and oats being the crops grown. The development of the plants is traced from germination to harvest, the superiority of those dressed with superphosphate being made clear throughout. A continuation of this report is to be given in the next number, where it is to be hoped that some form of tabulated summary will be appended, as the reader will find some difficulty in making a general review of the work as it is in diary form. Two lectures on the phosphoric acid question, delivered

at the 1928 meeting of the German Agricultural Society at Berlin, are reported, and notes of interest from other sources quoted. The journal is calculated to reach a cosmopolitan circle of readers, since it is published in columns of English, French, and German.

THE issue for June of *Antiquity* fully maintains the high standard in editing and in the interest and quality of its contributions, which so soon have gained for this periodical a place unique among magazines dealing with scientific subjects. It appeals to laymen without special knowledge, as well as to the scientific worker who wishes to keep abreast of recent developments outside his own special branch. In this issue Dr. D. Randall-MacIver continues his study of the early civilisations of Italy, a paper to which fuller reference is made elsewhere in this issue (p. 72), and Admiral Somerville describes two dolmens in the neighbourhood of Tours. Mr. Eric Thompson discusses the 'diffusionist' theory in relation to Central America, concluding that if extravagances are ignored, there is a case to be met, and that there are elements in late old empire times which have an Asiatic air when stripped of their purely Maya features. Mr. O. G. S. Crawford writes on 'Our Debt to Rome ?' tracing the history of Cranborne Chase and Grovely Forest from early to Elizabethan times, in relation to the question of continuity through the hiatus between A.D. 400 and A.D. 600. Excavations at Cyprus are described by Dr. Einar Gjerstad, and at Beisan by Dr. Alan Rowe. Mr. George H. Bushnell contributes an article on the Alexandrian Library. Some excellent notes on current and recent events in the archæological world, and a number of reviews, complete a highly interesting number.

THE annual conference of the German Bunsen-Gesellschaft für angewandte physikalische Chemie was held in May at Munich under the presidency of Dr. A. Mittasch of Ludwigshafen. The retiring president, Prof. K. Fajans, opened the proceedings on May 17, and during the next two days more than forty papers were read on subjects which covered a very wide range. Useful abstracts of many of these communications will be found in the *Chemiker-Zeitung* for May 26 and June 2. Prof. Sommerfeld lectured upon the use of atomic models, whilst many of the papers dealt with the various types of chemical combination, viewed under widely different aspects. Thus Dr. N. V. Sidgwick lectured on co-ordination and the electronic theory of valency, whilst Dr. F. Hund discussed combination from the point of view of the quantum theory. Prof. Debye dealt with electric moments of molecules and intermolecular forces, and also with the conductivity of strong electrolytes. Prof. Scheibe examined the evidence obtained from light absorption, whilst X-ray spectra were dealt with by Dr. O. Stelling, electrical conductivity by Prof. v. Hevesy, and the deformation of ions and molecules as deduced from refractometric measurements by Prof. Fajans. Amongst the many other topics were papers by Prof. Hönigschmidt on the atomic weight of silver, by Dr. Noddack on the chemistry of rhenium, and by Prof. Paneth on the age of meteorites calculated from their content of helium. Prof. Bodenstein of Berlin was elected to preside at next year's annual conference to be held in Berlin.

IT was in September 1852 that Foucault first showed the Paris Academy of Sciences how the rotation of the earth affected a gyroscope, and for half a century afterwards the gyroscope remained nothing but a piece of scientific apparatus. Its practical development has taken place in the last twenty-five years, and it is to-day used for navigation, for gunnery, for torpedoes, and for stabilisers. Ships are nowadays actually maintained on their course by the gyro compass itself, and in a recent issue of the *Sperryscope* it is stated that the s.s. *Pulpit Point* was kept on her course, S. 38° W., from San Francisco to Auckland during a voyage of 21 days entirely by the gyro compass. In the same issue is a note on the world's largest motor yacht, *Savarona*, 294 feet long, 2200 tons displacement, which during its maiden trip from the Delaware River encountered a severe gale, during which the rolling of the vessel was reduced from 26° to about 6° by means of the gyro stabiliser. In this vessel a gyro compass is used for navigating, the gyro stabiliser reduces the rolling, a small gyroscope controls the stabiliser, and on the trial a gyro-roll recorder, designed about fifteen years ago, recorded the rolling.

IN 1875, Prof. W. C. McIntosh published a volume entitled "The Marine Invertebrates and Fishes of St. Andrews," which has been of much use to successive generations of Scottish marine zoologists. Now, after the lapse of more than half a century, the veteran author, with help from some of his pupils and other friends, has compiled a volume of "Additions to the Marine Fauna of St. Andrews since 1874" (London, 1927). Like its predecessor, this volume is largely reprinted from papers that have appeared in the *Annals and Magazine of Natural History*. The three coloured plates illustrate some of the more striking forms that have occurred in the plankton. Naturally, some groups have received more attention than others. Prof. McIntosh's notes on the annelids are, of course, especially valuable, Mr. E. T. Browne has assisted in compiling the list of Coelentera, and Dr. W. Nicoll contributes an important list of parasitic worms, with the names of their hosts.

IN commemoration of the gift of £200,000 by the late Mr. H. H. Wills for the erection of the new Physical Laboratory in the University of Bristol, the Council has decided to found a Henry Herbert Wills Memorial Lecture in Physics to be delivered annually in the University. Sir J. H. Jeans has consented to give the first lecture, for which the date, Oct. 30, has been provisionally fixed.

REFERRING to a remark in the review of Forel's "The Social World of the Ants compared with that of Man," published in NATURE of May 26, Mr. J. B. S. Haldane points out that the observation that the size of insects is limited by their respiratory system, which works by diffusion, which was attributed to him by Prof. J. S. Huxley, was due to Prof. August Krogh.

THE Hector Medal and Prize of the New Zealand Institute for 1928 has been awarded to Prof. D. M. Y. Sommerville, of Victoria University College, Wellington, for his general mathematical work and for his investigations in non-Euclidian geometry. The medal is given yearly for distinction in different branches of science in rotation, in memory of the late Sir James Hector. This year the subjects of award were astronomy, mathematics, and physics.

THE Council of the Institute of Metals has accepted an invitation from the Verein Deutschen Ingenieure and the Deutsche Gesellschaft für Metallkunde to hold next year's autumn meeting of the Institute at Düsseldorf, in Germany. Düsseldorf is so readily accessible, and so full of interest for metallurgists, that the meeting, the first to be held in Germany by the Institute of Metals, is certain to be well attended and successful, supported as it will be by powerful German technical societies and by a large and enthusiastic German membership.

AT a meeting held on July 3, the council of the Institution of Professional Civil Servants unanimously adopted the following resolution: "The Council of the Institution of Professional Civil Servants, realising that the construction and maintenance of the architectural and engineering works controlled by Government Departments calls for the employment of highly qualified and experienced quantity surveyors, is of opinion that the attempt of the Air Ministry to recruit Assistant Surveyors from candidates who are below the age of 25 and are not required to have obtained by examination the appropriate professional diploma in quantity surveying, is calculated to lower the status of the surveying profession in the Civil Service and is contrary to the public interest."

THE thirteenth International Physiological Congress will meet at the Medical School of Harvard University, Boston, Massachusetts, on Aug. 19–23, 1929. The Federation of American Societies for Experimental Biology, which comprises the American Physiological Society, the American Society of Biological Chemists, the American Society for Experimental Pathology, and the American Society for Pharmacology and Experimental Therapeutics, will be hosts to the Congress, and Prof. William H. Howell, of Johns Hopkins University, will be the president. The arrangements for the Congress are in the hands of Prof. Walter B. Cannon, of the Harvard Medical School, who is chairman of the Congress Bureau, and Prof. Edwin J. Cohn and Alfred C. Redfield, who are the secretaries.

THE second International Congress of Radiology is to be held during this present month at Stockholm. There is little doubt that this will prove to be a very important gathering of X-ray workers from all parts of the world. In conjunction with the Congress an exhibition of apparatus is to be held in the Parliament House at Stockholm, and an important feature will be an exhibit of British-made X-ray apparatus, which is being contributed by the leading firms in this industry. Considerable importance is attached to this exhibit, for it is the first occasion on which it has been possible for British manufacturers to show their products on a large scale at such a congress outside Great Britain. The X-ray apparatus industry was, up to 1914, mainly in the hands of other countries. Since that time it has become established in England, and the present occasion gives indication of its steady growth and of the hope that at no distant future, Great Britain and the British Empire will be self-supporting in this important branch of scientific investigation. Particulars of the Congress can be obtained from the British Institute of Radiology, 32 Welbeck Street, London, W.1.

A USEFUL survey and index of statistics appearing in official publications issued in 1927 is provided by volume 6 of the annual *Guide to Current Official Statistics* issued by H.M. Stationery Office. Statisticians, economists, social workers, and other investigators will find that the *Guide* saves much labour in hunting up statistical references in government publications.

MR. W. H. ROBINSON, 4 Nelson Street, Newcastle-on-Tyne, has sent us a copy of his catalogue (No. 21) of "Old and Modern Books," comprising more than 1000 volumes dealing with bibliography, English and foreign literature, voyages, and travels. Copies can be had upon application to the bookseller.

THE second annual report for 1927 of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W.15, gives an account of some of the activities of the Institute. These include propaganda work on malaria control, and researches in the laboratories by Dr. Menon on the effects of Paris green on the aquatic stage of mosquitoes, on fungi and fungal diseases by Sir Aldo Castellani, and on the changes in the blood and tissues in cancer with reference to diagnosis and treatment by Dr. Shaw-Mackenzie. During the year, 73 in-patients were treated in the hospital, and an extension of accommodation is much needed. The balance sheet shows that the annual subscriptions have increased by only £200, and additional subscriptions and donations are necessary to develop the work of the Institute.

MESSRS. Ogilvy and Co., 20 Mortimer Street, London, W.1, have for disposal at reduced prices a number of second-hand and shop-soiled microscopes and microscopical accessories, microtomes, hæmacytometers, cameras, and other instruments and apparatus by Messrs. Leitz and other well-known makers. Catalogues may be obtained on application to Messrs. Ogilvy and Co.

A FURTHER catalogue (No. 196) just received from the enterprising firm of Max Weg, of Leipzig, contains details of a very large stock of literature and maps relating to the geology of Germany. Its 10,058 items, which fill 296 pages, are classified geographically in 22 sections, and range from short 'separates' to long runs of periodicals. The prices appear very reasonable, and both this and the several other catalogues recently issued by the same firm should prove very

helpful to the student endeavouring to get together the literature of some particular branch of geology.

MESSRS. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have just circulated an important catalogue (No. 417) of upwards of 1800 second-hand works on zoology and geology, classified as follows: general works, zoology (anatomy, anthropology, arachnida, conchology and mollusca, crustacea, entomology, ichthyology, mammalia, ornithology, reptilia, echinodermata, infusoria, polyzoa, zoophytes, microscopy, etc.), geology, palaeontology, etc. The list includes the entomological library of G. T. Bethune-Baker and a selection from the library of W. de Selys Longchamps.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An honorary lecturer on tropical diseases at Westminster Hospital Medical School, S.W.1—The Dean, Westminster Hospital School of Medicine, 12 Caxton Street, S.W.1 (July 16). A research studentship at St. Mary's Hospital, Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (July 17). A teacher of engineering and allied subjects at the Barnstaple and Bideford Technical Schools—The Secretary, County Education Office, Exeter (July 19). A head of the mechanical and civil engineering department, and a lecturer in the same department of the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland (July 20). An assistant lecturer and demonstrator in organic chemistry at East London College—The Registrar, East London College, Mile End Road, E.1 (July 31). A lecturer in economics in the United College of St. Salvator and St. Leonard, St. Andrews University—The Secretary and Registrar, The University, St. Andrews (Aug. 31). An assistant lecturer in geography in the University of Bristol—The Secretary, The University, Bristol (Sept. 10). An inspector under the Fertilisers and Feeding Stuffs Act, 1926, and assistant agricultural analyst, under the Devon County Council—The Clerk to the Devon County Council, The Castle, Exeter. A graduate in engineering subjects for the Dursley Secondary School and Evening Institute—The Headmaster, Secondary School and Evening Institute, Dursley, Gloucestershire. Part-time teachers in gas fitting (calculations and drawing), building construction, and science for builders at the Erith Technical College—The Principal, Erith Technical College, Belvedere, Kent. A full-time assistant master to teach engineering and workshop practice at the Kingston-upon-Thames Technical College—The Principal, Technical College, Kingston-upon-Thames.

Our Astronomical Column.

MIRA VARIABLES AND THE MILLIKAN RAYS.—Mr. Axel Corlin, of the Lund Observatory, suggested some time ago that the variation in intensity in the Millikan rays according to the R.A. of the meridian might be due to the rays coming, either wholly or partly, from Mira variables when near maximum. He found a theoretical curve from the maxima of known stars of this type, the date chosen being Sept. 12, 1926. This curve fell below the observed intensity of the rays in the region R.A. 16^h to 23^h. In reply to some objections raised, he returns to the subject in *Astr. Nach.*, No. 5566, using a larger list of Mira variables and including all that were within a quarter period of light maximum on the chosen day. He has thus secured a closer agreement with observation. He considers that the observed variation of intensity with sidereal time shows that the rays come from definite centres in the heavens; these centres may be either Mira stars or unknown cosmical clouds.

FAMILIES OF ASTEROIDS.—Prof. K. Hirayama announced in 1922 his detection of five families among the asteroids, the members of each family having such closely related orbits that it was conjectured that each family might have arisen from the separation of a single body. He contributes another article on the subject to the *Japanese Journal of Astronomy and Geophysics*, vol. 5, No. 3. He uses later determinations of elements, and corrects his former values to a small extent, but the conclusions as regards the five families remain unchanged. He now adds five new families, of which one, named after Phocaea, has eleven members, but the others are very small. The Desiderata family has five, the Pallas family three, while the remaining families have two each. These last have small perihelion distances, and approach the earth fairly closely. Æthra and Ganymed are linked together, also Albert and Alinda; the resemblance between the orbits of the last two had been noted by others. Incidentally, a principle of asteroid nomenclature was violated here. It was agreed that asteroids with exceptional orbits should have masculine names. This principle was carried out in Albert's case but not in that of Alinda.

SOLAR HYDROGEN FILAMENTS.—The dark filaments of the sun's upper atmosphere are now regularly observed at several solar observatories by means of spectroheliographs working at a limited portion of the middle of the spectrum lines of calcium, *H* or *K*, or of the hydrogen line, *Hα*. In a recent publication, *Annales de l'Observatoire de Paris, Section de Meudon*, Tome 6, detailed charts of dark filaments, together with tables, are given for the period March 1919–January 1920. Each chart, which embodies the observations extending over one rotation of the sun, shows sunspots, calcium flocculi, and dark filaments, thus affording an instructive comparison between these different phenomena. The solar latitude and longitude of these objects, which are traced in outline, can be easily read off from the charts. By a suitable notation other details of the filaments are given concerning their growth, duration, and movement.

A glance through the charts shows very clearly the chief characteristics of the dark filaments: namely, (1) their much longer life as compared with sunspots; (2) their distribution in solar latitude, both within the spot zones (where, however, they frequently appear apart from the spots) and also in high latitudes; (3) their great extent in longitude; (4) their marked inclination to the sun's equator. It is generally accepted that prominences and filaments are one and the same thing, the former being seen in silhouette at the sun's limbs, the latter as dark markings projected, whilst in transit, against the more brilliant background of the disc. An extended series of these charts would be of great use to those who study the relationship between various solar phenomena and also to those interested in solar-terrestrial relationships.

Research Items.

FORERUNNERS OF THE ROMANS.—Under this title Dr. D. Randall-MacIver continues in *Antiquity* for June the study of the early civilisations of Italy, which he began in the issue of that periodical for June 1927. At about 1000 B.C., that is, about the beginning of the Iron Age and two centuries before the effective coming of the Etruscans, northern and central Italy may be partitioned into five distinct spheres. The north-west is occupied by the Comacines, part of Venetia by the Atestines, the Bolognese region by the northern Villanovans, Tuscany and a part of Latium by the southern Villanovans, east of the Apennines, from Rimini to Aufidena, the Adriatic coast, and the central Apennines are held by the Picenes, including some of the Samnites and some Umbrians. The first four are related and practise cremation; but the Picenes are of wholly different origin and practise inhumation. In several parts of the country these civilisations maintained an independent existence down to the fourth century B.C. The most important contribution to the early Iron Age culture of Italy was undoubtedly that of the two Villanovan nations, and in Etruria the Etruscans owed more to them than has been appreciated. They were the pioneers in metal-working, and it was to their coppersmiths that the Etruscans owed their supremacy in the metal trade of the Mediterranean. The highest point of the Atestine culture of Venetia is between the seventh and fifth centuries. They were probably the latest of the cremating nations to settle in Italy. Originally they were closely related to the Villanovans and kept in close touch with them. The Picenes, it is suggested, are the descendants of the original neolithic population, who above all were warriors—a reef against which Villanovan and Atestine migration beat in vain.

A MAORI FEEDING FUNNEL.—In the *Museum Journal* (Philadelphia) for March, Mr. R. U. Hall describes a feeding funnel now in the University Museum which was used for administering liquid food to persons who were undergoing the process of being tattooed. It is roughly in the form of an inverted cone, distorted so that the slope of one face was longer, or developed more gradually than that of the other. Each of these two faces led to a grotesque and distorted human figure on the rim of the funnel. Most of the published examples of such funnels are almost entirely covered with the characteristic Maori scroll and spiral ornament. The present example differs in that the ornament is confined to the two faces mentioned and the side and top of the rim. It is also more slender and graceful in form, while the rim is a shelf-like projection. It shows the tool marks of the stone implement with which it was carved, and is therefore of a considerable age. It is suggested that it is the work of a talented amateur rather than a professional wood carver. The figures are male and female, and differ in their method of representation. The head of the male figure is carved on the rim of the funnel, and its body and limbs appear on the tubular portion of the vessel, being built up of a number of spirals and concentric arcs of circles. The hip ornaments represent the *rape* or buttock pattern of the body-tattoo. The place occupied by the face, being too small for a realistic representation of the tattoo pattern, is filled in with concentric arcs. The female figure, in contrast, is carved wholly on the rim, the limbs and body being distorted to fit, mainly on an undercut downward extension of the rim, so that the whole figure is contained in a lozenge-shaped space. A second difference, one following the custom of real life, is that the face is undecorated except for the woman's tattoo confined to the lips and sides of the chin.

THE GESTALT THEORY.—The May issue of *Scientia* (vol. 43; 1928) contains a discussion on the *Gestalt* theory, in which Prof. E. Rignano and Prof. Köhler attempt to interpret one another's points of view. Prof. Köhler is one of the most enthusiastic workers in this field, and he includes under the word *Gestalt* "those structures which as wholes possess specific properties and therefore can with good right be regarded as unities." Some exponents are primarily concerned with the problems of the perception of 'shape,' but others have extended it to cover most of the operations of sensory perception. This results in a certain ambiguity of expression, and considerable divergence of opinion even among the supporters of the theory, who would seem to be agreed on but one thing, namely, to oppose the associationist school of psychology. Prof. Rignano supports the older view; he has difficulty in reconciling the different usages of the word *Gestalt*, and also finds the theoretical consequences confused. Prof. Köhler answers him with a very clear exposition of his point of view. The English reader who has been familiar with the discussion in somewhat modified form in Prof. Stout's writings, and later in Prof. Spearman's, cannot avoid the feeling that the disputants are dealing with different aspects of the problem, or at least seeing it in different perspectives. There is much experimental evidence in favour of the *Gestalt* hypothesis, but 'hypothesis' would still be logically more correct than 'theory' as a description of the system.

TRITRICHOMONAS FECALIS.—This was found by L. R. Cleveland (*Amer. Jour. Hygiene*, vol. 8, No. 2; 1928) in human fæces which had been in tap water from 15 to 25 days. It could not be demonstrated in the fæces before they were placed in water, but by heating one-half of a stool and placing it in water while the other half not heated was placed in sterile tap water in a sterile jar, it was shown that the organism was in the fæces, for in five experiments it was never obtained from the heated portion of the stools but invariably from the unheated portion. Heating of the fæces did not render them unsuitable for the growth of the Trichomonas, because it grew in them when added from other cultures. It has been maintained for three years in fæces placed in tap water, and will grow in any fluid which supports bacterial growth. It will ingest red blood cells, yeasts, and starch grains, but cannot live on red blood cells without bacteria. When grown anærobically in pure cultures of certain bacteria, the Trichomonas becomes exceedingly abundant. Multiple fission was constantly taking place, and it was found possible to induce this at will by crowding the organisms—this is the first record of multiple fission in a human trichomonad. Examples with from three to at least one hundred nuclei were observed. Trichomonads of many animals were placed in fæces diluted with tap-water, but none grew except *Tritrichomonas augusta* from the frog. *T. fecalis* is less than half the size of *T. augusta*, and differs from the latter in having no granules in the axostyle or in the cytoplasm.

PHOTOSYNTHESIS OF DIATOM CULTURES IN THE SEA.—Continuing their excellent work based in the Millport Marine Station, Miss S. M. Marshall and Mr. A. P. Orr report on experiments carried out with cultures of diatoms contained in glass bottles suspended in the sea (*Jour. Mar. Biol. Assoc.*, 15, 1;

1928). A persistent culture of *Coscinosira polychorda* was used. The bottles containing the cultures were suspended at various depths, some exposed to light, others covered. The 'compensation point,' at which the amount of oxygen produced by photosynthesis is balanced by the amount used in respiration, was found to lie at a depth of 20-30 metres in summer. In winter it is close to the surface in coastal water. The optimum position for photosynthesis is never at the surface, even in winter, but some metres down. The experimental results are carefully considered in relation to the similar work of Gaarder and Gran and the authors' own researches in Loch Striven, and add much to our knowledge of this fundamental question.

NITRATE IN THE SEA.—H. W. Harvey continues (in *Jour. Mar. Biol. Assoc.*, 15, 1; 1928) his interesting studies on the occurrence and seasonal variation in the English Channel of this important limiting factor in plant production in the sea. He confirms his previous conclusion that the nitrates are almost entirely utilised by phyto-plankton in the summer and are re-formed in early autumn. Regeneration takes place in the deeper layers, but the exact mechanism is not yet known. The interesting observation is made that the effect of land drainage on the quantity of nitrate is apparent for only a few miles from shore, and most of the nitrate entering Plymouth Sound in river and estuarine waters is used up by plants before it reaches open sea, at least in summer.

PLANT GENETICS.—Crosses have been studied by Dr. R. J. Chittenden (*Jour. of Genetics*, vol. 19, No. 3) of a number of *Primula* species, Vesicales section, including *P. Juliæ*, *P. acaulis*, *P. elatior*, and *P. officinalis*. All have as chromosome number $n=11$. Their hybrids are very fertile, with highly regular reduction divisions. The *Godetia* species studied fall into two groups: (A), including *G. amœna* and *G. Whitneyi* ($n=7$), intercross, but the hybrids are highly sterile; (B), containing *G. Bottæ* ($n=9$), *G. tenella* ($n=16$), and *G. lepida* ($n=26$). *G. Bottæ* will cross with *G. tenella* and the latter with *G. lepida*, but the hybrids are sterile. Groups (A) and (B) will not intercross. Six species of *Nemophila* ($n=9$) were also studied. Although four of the species are closely allied, they all refuse to intercross. Nevertheless, from a study of their variations, conclusions are reached regarding their probable genetic composition. In the genus *Phacelia* four species were examined ($n=11$). Two of the species were sterile with all the others, but the other two (*P. Parryi* and *P. Whitlavia*) may belong to the same species. Numerous parallel variations were found in the various genera. Thus in *Primula*, the pin and thrum types are present in all these species. Mauve and white flowers occur in two of the species of *Godetia*. Two species of *Nemophila* have a spotted and a uniform corolla colour, while in *Phacelia* two species have white and purple varieties. These variety characters show the same relations of dominance or recessiveness in different species of the same genus, for example, thrum being always dominant to pin, and the semi-glabrous condition of *P. Juliæ* dominant to the hairy condition in other species. A curious case is the occurrence of plants heterozygous for an inhibitor of a character which is not found in the species but is present in related species.

NEW SOURCE OF DIAMONDS IN SOUTH AFRICA.—In addition to the kimberlite pipes and derived gravels which constitute the source of most of the South African diamonds, the Witwatersrand bankets and the Upper Triassic Forest Sandstone are also known to be diamondiferous. A further occurrence in the chert beds of the Dolomite series (Transvaal System) has now been recorded by David Draper in the *Trans. Geol. Soc. S. Africa*, vol. 30, pp. 57-68; 1928. Following the marine transgression which led to the deposition of the great Dolomite series, a temporary regression of the sea made possible the formation of breccias and conglomerates from the newly exposed cherts and dolomites. At this time the diamonds were introduced from an adjoining elevated land surface, just as at the present time in Brazil and Borneo diamonds are being transported to lagoons and shore-lines where coral reefs are in process of formation. The productive fields are in the Lichtenburg and Ventersdorp districts in the south-western Transvaal, and their importance may be realised from the output for November 1926, which amounted to above 120,000 carats, valued at more than half a million sterling. Corundum occurs in the concentrates, suggesting that the ultimate source may have lain in the north-eastern Transvaal, where possibly it has been since obliterated by the intrusion of the great Bushveld complex.

THE UPPER ATMOSPHERE.—*Die Naturwissenschaften* for May 4 contains an interesting summary of our present knowledge of the upper layers of the earth's atmosphere, in an article (with brief bibliography) by J. Bartels. The sources of information touched on are very varied—meteors, luminous high clouds, auroræ, ozone, long-distance propagation of sound, terrestrial magnetic variations, and radio propagation; the extent to which the temperature, density, pressure, composition, and ionisation of the upper layers can be considered known is indicated.

THIN METALLIC FILMS.—In a recent issue (No. 8) of the *Annalen der Physik*, E. Rupp has described a neat method for preparing extremely thin foil. A small piece of metal is put in a tungsten boat in a vacuum furnace, and after preliminary purification *in situ*, part of it is distilled on to a highly polished rock salt plate. Heating is arrested when a sufficient quantity has been deposited, and the rock salt then transferred to a salt solution, where it dissolves and leaves the metal floating in the liquid, from which it can be lifted on a frame. Layers as thin as 10^{-6} cm., free from holes, can be prepared and handled in this way, and have been used for studying the diffraction of slow electrons by the Debye–Scherrer X-ray method, in a modified Ramsauer apparatus.

PHOSPHORESCENCE.—Prof. R. W. Pohl has given a valuable summary of some of the electrical and optical properties of phosphorescent crystals in the issue of *Die Naturwissenschaften* for June 15. The outstanding new result which he mentions is that their resistance for electron currents is proportional to the absolute temperature, a fact of particular significance since the same law holds for metals, where it has required the wave-mechanics for its explanation. One gathers from Prof. Pohl's article that the importance of these phosphors from the chemical and crystallographic point of view lies in their optical behaviour being that of a mixed crystal, and since the component responsible for the after-emission of radiation is present in vanishingly small quantity, its absorption spectrum and natural ultra-violet frequencies can thus be found with it in a dilute solid solution in an almost transparent matrix, instead of in a thin film of the pure substance that can only be prepared with some difficulty. It is an interesting point that measurement of the internal photoelectric current of a phosphor still provides the most direct proof of the rule that one electron is liberated for each radiant quantum absorbed.

ELECTRIC SPARKS.—The three experimental papers on the form and structure of electric sparks, by T.

Terada and U. Nakaya, published in volume 8 of the *Scientific Papers of the Institute of Physical and Chemical Research, Tokyo*, are instructive to scientific workers and will be useful to magneto manufacturers. The authors point out that our present knowledge of the form and structure of sparks is not much greater than in the days of Franklin and Lichtenberg. For example, the spark between the electrodes of a Wimshurst machine, instead of taking the shortest path, takes an irregular, bow-shaped curve with a right-angled bend on it. They give pictures of many zigzag sparks and point out the analogy with the 'discharge canal' in Lichtenberg's figures. Their most important results are in connexion with the straight and smooth type of spark sometimes observed. They found that this could always be secured by making a definite leak of electricity from the positive electrode. This was most readily secured by attaching a needle point to the positive electrode, from which a brush discharge takes place. This kind of spark they call a 'three-part' spark. Apparently the same spark is produced whether the needle is at a distance of 30 cm. or at a distance of 150 cm. from the spark. They conclude that the effect is neither directly due to the ions emitted from the point nor to any other kind of radiation which it may emit. If there is leakage on the negative lead, the three-part spark, or the 'fat spark' as it is called sometimes by magneto manufacturers, is not produced. It is advisable, therefore, to protect the negative lead with ebonite tubing. When an air blast is directed to the positive end of the three-part spark, its path makes a large curve at this end. When it is directed to the middle part of the spark nothing happens. When it is directed to the negative end, the number of sparks is greatly diminished and sometimes they stop altogether. If the voltage is increased, the air blast being applied to the negative end, the spark takes the zigzag form. Earthing the positive electrode produces the same effect as attaching a needle point to it.

EARLY MATHEMATICS IN SCOTLAND.—A paper of only forty pages naturally gives room for no more than a very rapid sketch of its subject; but within these limits Prof. G. A. Gibson, in a "Sketch of the History of Mathematics in Scotland to the end of the 18th Century" (*Proceedings of the Edinburgh Mathematical Society*, vol. 1, pts. 1 and 2, 1927–28), has given useful references to the work of men who are famous for original discoveries, or for their ability and success as teachers, or both. He deals with John Napier (1550–1617), James Gregory (1638–1675) and his nephew David Gregory (1661–1708), Robert Simson (1687–1768), James Stirling (1692–1720), Colin Maclaurin (1698–1746), Matthew Stewart (1717–1785), John Playfair (1748–1819), and Sir John Leslie (1766–1832). We are also given some interesting particulars of the state of mathematical studies in the schools and universities of Scotland at various dates. In Scotland, as in England, mathematics (arithmetic, geometry, and algebra) was not taken as a subject of education in schools until the latter half of the seventeenth century. In the universities, up to the time of the Reformation, the course included the "Sphere" (presumably the famous thirteenth-century work by Sacrobosco) and the "Physics," "De Caelo," "De Ortu et Interitu" and "Meteorologica" of Aristotle, but the mathematical subjects consisted of nothing more than arithmetic and very elementary geometry. Definite mention of arithmetic as a school subject begins in 1628. Only with the establishment from 1760 onwards of a new type of school more advanced than the grammar school and called by the name of "Academy" does a programme of higher mathematics appear in the curriculum extending, beyond plane and spherical geometry, to such things as the theory of equations, the differential calculus, statics, dynamics, hydrostatics, and optics, and it is not probable that this programme was at first carried out in the schools with any degree of thoroughness.

SPECIFIC HEATS OF SALT SOLUTIONS.—At room temperature, electrolytic solutions have an abnormally small heat capacity, and a mathematical theory to account for this has been advanced by Zwicky. He showed that in the vicinity of each ion a very high pressure could be set up due to the attraction exerted by the ionic field upon the dipoles of the water molecules. At room temperature, increase of pressure decreases the heat capacity of water, and hence an electrolytic solution should have a low specific heat. With rise of temperature, the heat capacity of compressed water increases, and therefore salt solutions should behave similarly. An attempt to test this theory experimentally is being made by F. T. Gucker, who describes some preliminary results in the *Journal of the American Chemical Society* for April. He employs an adiabatic twin calorimeter apparatus, with which, it is claimed, the specific heats of solutions may be found with an accuracy of 0·05 per cent. The results with potassium nitrate and chloride solutions do not uphold the above theory, although, as Zwicky has pointed out, the hydration of the ions may mask the effect of increase of pressure.

THE 'UNSATURATED HYDROCARBONS' IN THE GASES FROM THE CARBONISATION OF COAL.—In technical terminology the 'unsaturated hydrocarbons' in fuel gases are those which are absorbed by bromine or by concentrated sulphuric acid, and recent suggestions for their commercial utilisation has made it desirable to obtain a more detailed knowledge of the composition of these constituents. A convenient method for the determination of the unsaturated gaseous compounds present in coal gas is described by A. B. Manning, J. G. King, and F. S. Sinnatt in *Technical Paper No. 19* of the Fuel Research Section of the Department of Scientific and Industrial Research (London: H.M. Stationery Office). After the removal of the liquid constituents of the gas the unsaturated substances are separated as the bromine compounds, which are fractioned and the original hydrocarbons regenerated by the action of a zinc-copper couple. The resulting gas is analysed by treatment with strong sulphuric acid and combustion over copper oxide. The paper contains a detailed account of the apparatus used and some of the results obtained with gases from both low and high temperature carbonisation of coal.

CARBON MONOXIDE FROM GAS FIRES.—The Joint Research Committee of the Institution of Gas Engineers and the University of Leeds has issued its seventeenth Report, which records further study of the products of combustion of typical gas appliances, and in particular the evolution of carbon monoxide in the flue gases from gas fires. For this purpose a very refined modification of the iodine pentoxide method was employed, and indeed necessary, to detect and measure the small quantity of carbon monoxide passing from a modern gas fire. This reached 30 parts per 10,000 of gas burned in such a fire when properly regulated. The actual concentration in the flue gases is, however, much less—it may be so little as one two hundred and fiftieth of this owing to the dilution of the flue gases, which varies from case to case. Small as this is, in view of the volume of gas burned in such appliances, the usual practice of fixing them to efficient flues is considered to be advisable.

The Winnipeg Meeting of the Royal Society of Canada.

ON May 22–24, the Royal Society of Canada met west of Ottawa for the first time. Meetings were held in Winnipeg (the meeting place of the British Association in 1909, and the future meeting place of the British Medical Association in 1930) in the University of Manitoba and the Legislative Building.

Dr. A. H. R. Buller, professor of botany in the University of Manitoba, delivered the presidential address on "The Plants of Canada, Past and Present." He treated of Dawson's *Eozoon canadense*, the algæ obtained by Walcott from the Middle Cambrian shale of British Columbia, *Psilophyton* and the Devonian land flora, the Great Ice Age and the relic flora in Eastern Canada. The number of plant species in Canada, Canadian weeds, Canadian forests and their products, were described, and reference was made to the white pine blister rust disease, wheat in the West, the black stem rust disease of wheat, and to J. H. Craigie's investigations on sex in the rust fungi. Prof. Buller made a plea for a systematic botanical survey of Canada as a whole, and for the establishment of botanical gardens in various parts of the Dominion.

The annual popular address was given by Prof. J. J. R. MacLeod, of Toronto (now Regius professor of physiology of the University of Aberdeen), who took as his subject "The Air we breathe." He showed by a historical survey the close intertwining of chemical and physiological discoveries of the nature of atmospheric air and its utilisation by the organism.

The Government of Manitoba entertained the fellows of the Society at a reception and a luncheon while the final session of the meeting was held at the historic Lower Fort Garry, twenty miles north of the city, where the fellows were entertained by the Canadian Committee of the "Governor and Company of Adventurers of England trading into Hudson's Bay."

A number of papers on historical and literary topics were communicated in Sections I. and II. (French and English history and literature). Amongst the 179 papers communicated in the scientific sections, the following may be noted:

In Section III. (Physics, Mathematics, Astronomy, and Chemistry), Dr. H. M. Tory, in his sectional presidential address, dealt with comparative conditions of industrial research in various countries. In a paper entitled "The Gyromagnetic Electron and Wave Mechanics," Dr. L. V. King gave a mathematical discussion, in which from the classical dynamical theory he showed that equations of wave mechanics can be derived. Prof. J. C. McLennan and his associates gave a series of papers on various phases of spectral analysis, on the decomposition of ammonia by cathode rays, on the intensities of the light of the oxygen green line of the night sky, on the photoelectric effect at very low temperatures, etc. E. F. Burton ("A New Method of Measuring Electrical Conductivities of Materials by Use of an Oscillating Circuit") described an exceedingly sensitive quantitative procedure which will detect very small quantities of moisture. J. S. Foster and W. Rowles communicated "Further Observations on the Stark-Effect in Neon," in which the intensities are found to agree with those calculated by Schrödinger. In "A Method of Estimating Relative Conductivities of the Earth, using a Potential Method, either along Lines or over Areas," Prof. A. S. Eve dealt with the geophysical location of ore deposits. F. Allen and collaborators communicated papers on the correlation of colour blindness, anomalous vision, and normal colour vision, and the oscillatory effect in vision.

Other physical and mathematical papers included: J. F. Plaskett on the rotation of the galaxy; R. W. Boyle and S. C. Morgan on some measurements of ultra-sonic velocities in liquids; G. M. Shrum, C. G. Patten, and H. D. Smith on the change in the optical transparency of certain samples of ultra-violet glass after exposure to X-rays; R. M. Stuart on the theory of an elastic tape; D. Buchanan on the ellipsoidal pendulum; S. Beatty on planar harmonic conjugacy; and W. J. Webber on the Fourier series of a bounded function.

Amongst chemical papers presented were a series by G. S. Whitby and associates on problems related to rubber, several by T. Thorvaldson and associates dealing with the chemistry and physical chemistry of hydraulic cements, a paper by Miss E. V. Eastcott describing the isolation of crystals of Bios I., identified as inositol, "High Voltage Arcing and A. C. Electrolysis" by J. W. Shipley and C. F. Goodeve, the "Dielectric Constant of Pure Hydrogen Peroxide" by A. C. Cuthbertson and O. Maass, and "Correlations between the Total Nitrogen of the Bases and Arginine and Lysine Nitrogen of Various Proteins" by R. K. Larmour, the last paper yielding evidence supporting Kossel's hypothesis that arginine is the nucleus of the protein molecule.

The papers in Section IV. (Geological Sciences) had reference more particularly to phases of Western Canadian geology. W. A. Johnston dealt with the Lake Agassiz beaches, in their continuation northwards beyond the area mapped by Upham, with a critical discussion on adjustment of level since the time of the maximum extension of the lake. M. Y. Williams discussed the changes of level in Tertiary and post-Tertiary times in Southern Saskatchewan and Alberta. The petrographical character of the Whitemud and Ravenscrag beds was dealt with by F. H. McLearn, and the nature of the heavy minerals in the western sand horizons, particularly in Manitoba and Eastern Saskatchewan, by R. C. Wallace and his students. Further detail on the structural peculiarities of the dolomitised areas in the Manitoba Ordovician limestones was given by D. J. Birse. S. R. Kirk presented evidence to show that the conodonts of the Harding beds of Colorado are to be referred to ostracoderm plates. The historical data referring to the St. Lawrence earthquake of 1663 were assembled by E. A. Hodgson. T. C. Phemister discussed the genetic relationships of the Sudbury gabbro and Cobalt diastase. P. S. Warren described the Devonian and Carboniferous rocks of the Crowsnest Pass section, and in a second communication assembled the sedimentary record of the Rocky Mountain section at the 51st parallel. R. L. Rutherford presented evidence of considerable post-glacial uplift in South-western Alberta.

In the sectional presidential address to Section V. (Biological Sciences), Prof. J. J. R. MacLeod dealt with the present knowledge of carbohydrate metabolism and insulin action. F. E. Lloyd gave a kinematograph demonstration of the contractile vacuoles of *Paramecium*, and V. H. K. Moorhouse a similar demonstration of postural reflexes in spinal dogs, while Frère Marie-Victorin gave a series of papers dealing with eastern Canadian plants. W. P. Thompson presented papers on dwarfness and species-hybrids in wheat, Prof. A. H. R. Buller a paper on the blocking layer and the luminosity of the mycelium of *Armillaria mellea*. A. T. Cameron dealt with seasonal variations in the calcium content of the blood serum of the young rat, V. J. Harding with a comparison of the alkalinity of urine produced by sodium and potassium citrates, J. Miller with the muscular movements of the appendix

and their relation to appendicitis, and C. C. Macklin with the macrophages of the lung alveoli. C. M. Fraser discussed the ecology of the butter clam, F. C. Gilliatt the bionomics of the tortracid moth *Eulia mariana* (a new orchard pest which has developed in Nova Scotia), while S. Hadwen dealt with colour changes in animals, Miss H. I. Battle with the development of structural anomalies in the four-bearded rockling due to unfavourable temperatures and salinities during early stages, and J. M. D. Scott with pregnancy anæmia in rats.

Monseigneur Camille Roy, of Laval University, Quebec, was elected president, and Prof. A. S. Eve, of McGill University, vice-president, for 1928-29.

Kiln-Seasoning of Timber.

THE natural seasoning of timber by allowing it to remain stacked or otherwise for a varying period of time was well understood in Great Britain, and seasoned timber, especially for the better class of work, was in common use. During the progress of the War the stocks of seasoned timber were utilised, and kiln-seasoning, where seasoned material was indispensable, as, for example, for aircraft work, came to be relied on more and more. Experiments were also inaugurated in other parts of the British Empire with the object of endeavouring to place upon the market kiln-seasoned wood of some of the broad-leaved soft-wooded species from the tropical and sub-tropical forests which had previously been unmarketable. Kiln-seasoning thus began to assume an important position, where timber was in question, in commercial centres. So much so that repeated inquiries for advice have been addressed to the Director of the newly established Forest Products Research Laboratory at Princes Risborough. With the view of making public the research work being carried out in this direction, a report entitled "The Principles of Kiln-Seasoning of Timber" (*Special Report No. 2*) is being prepared, of which Part 1., "Types of Commercial Kilns in Use," by Mr. S. T. C. Stillwell, has been issued.

In an introduction the troubles attendant on drying timber are discussed. A correct appreciation of these difficulties is necessary in order to estimate the value of the use of the kiln method. "If we consider a board of green timber," says the writer, "which is allowed to dry freely, the surface layers quickly lose their free moisture; this is followed by evaporation from the cell walls, and a corresponding shrinkage then takes place in the surface structure. In the meantime, though there is a tendency on the part of the moisture in the centre portion of the board to move towards the surface layers as soon as these become drier, the amount of moisture so moving is much smaller than the amount evaporated from the surface. It is inevitable, therefore, that the surface layers will tend to shrink before the centre portion is ready to do so, and, as a result, tension is set up in these layers." Regulation of the rate of drying from the surface is therefore essential and requires to be under control. This control involves the regulation of humidity, temperature, and the circulation of air, and that the latter should be changed regularly and frequently in the kiln.

Before dealing with the types of kilns, kiln treatment is briefly discussed. It may be mentioned that almost invariably the timber placed in the kiln is first warmed up by a circulation of saturated or nearly saturated air, driven through it by various devices, to a temperature slightly higher than that at which drying is to commence. This is said to be doubly advantageous since it both warms the timber in the centre, thus afterwards assisting in the transfusion of moisture from the centre to the surface, and also relieves any existing stresses in the surface layers.

Five different types of kiln are fully described and clearly illustrated in the report, these kilns being known as (1) natural circulation ventilated kiln, (2) tunnel or progressive kiln, (3) water-spray kiln, (4) external fan kiln, and (5) internal fan kiln. For their varied features and uses the report should be consulted.

The writer concludes with some brief notes upon lay-out, equipment, and kiln staff. A subsequent Part II. is promised, dealing with the field of kiln instruments, which is said to be both wide and important. Mr. Stillwell emphasises the importance of employing a good man, with scientific and engineering training, to supervise the seasoning operation. "Practically," he says, and the point is worth stressing, "all the prejudice which at present exists against kiln-seasoned timber can be attributed to the short-sighted policy of many commercial firms in putting their kiln plant in charge of men of little education and no experience as kiln operators."

The important work upon which this report is based can be safely recommended to all those in the British Empire who deal with timber in its many aspects.

Flowering Plant Hybrids.

THE Masters Lectures for 1927, delivered by Dr. C. H. Ostenfeld of Copenhagen on "The Present State of Knowledge on Hybrids between Species of Flowering Plants," have been published in the *Journal of the Royal Horticultural Society*, vol. 53, Part 1. Dr. Ostenfeld reviews past and present concepts of species, but finds it no more possible now than it was forty years ago to formulate a definition of a 'species' which possesses at the same time practical advantages and scientific accuracy. Any definitions which embody such modern concepts as 'microspecies,' 'ecospecies,' or 'genospecies' are for practical purpose useless. On the other hand, a practical definition which satisfies all minds and all ideas must necessarily possess a somewhat vague connotation.

In spite of the lack of a definition which is at once apt and generally applicable, species in Nature are rather well-defined, a characteristic which their ability to hybridise fails to modify. This is explained either by the sterility of the hybrids themselves, or by the ease of back-crossing with one or other of the parents as against 'selfing.' Any external sign of hybridity is thus quickly effaced.

Dr. Ostenfeld discusses some of the most recent work on the formation by hybridisation of new types which fail to segregate and are thus wholly or partially stable. Related species with the same number of chromosomes usually produce fertile hybrids, while sterile hybrids are usually produced when the parents have different chromosome numbers. The Japanese botanist Kihara has, however, succeeded in obtaining fertile hybrids in a cross between two species of *Triticum* with different chromosome numbers. The offspring with chromosome numbers the same as either of the parents were most fertile, while those with the intermediate number were very much less so. Thus a selective process goes on, resulting in the disappearance of intermediate forms.

The Danish geneticist, Winge, has advanced a theory that a new stable type could be produced by hybridisation of two species, if the chromosomes of

the hybrid were split longitudinally and thus doubled. This hypothesis explains many cases which cannot otherwise be understood, particularly the cases of some of our cultivated plants, which are obviously hybrids but yet breed true to type without showing any segregation in the offspring. Longley (1926) has advanced some definite data in the case of *Fragaria*, and in crossing two species with the same number of chromosomes, got in one case an individual with double that number of chromosomes which was morphologically distinct and bred constant.

University and Educational Intelligence.

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred on Emeritus Prof. J. D. MacWilliam, formerly Regius professor of physiology in the University. The degree of D.Sc. was conferred on Miss I. Gordon for a thesis entitled "Studies in the Development of the Skeleton in Echinoderms," and on Mr. E. V. Laing for a thesis entitled "Studies on Tree Roots: their Action and Development, with special reference to Mycorrhiza and Tree Growth on Peat Soils."

BRISTOL.—At a congregation held on June 30, the degree of D.Litt. was conferred upon Mr. E. J. Holmyard, head of the Science Department at Clifton College.

MANCHESTER.—Applications are invited for two Grisedale scholarships for biological research, tenable, respectively, in the botanical and zoological departments of the University. Each scholarship is of the yearly value of £100, and the award is open to graduates in botany and zoology, with some experience of research. Applications must reach the Registrar by July 29 at latest.

ST. ANDREWS.—Viscount Haldane of Cloan has been elected to the office of Chancellor of the University.

Prof. John McGibbon, professor of obstetrics in the University of the Witwatersrand, Johannesburg, has been appointed professor of midwifery and gynæcology in succession to Prof. Kynoch, who has recently resigned the chair.

MR. WASHINGTON SINGER, formerly of Paignton, has presented a sum of £25,000 to the University College of the South-West, Exeter, for the building of a chemistry laboratory. It had been decided to build a new physics laboratory on the recently acquired 100-acre site on the Streatham Estate, Exeter, and the cost of that building will be met with moneys raised by the general appeal. The welcome and generous gift of Mr. Washington Singer will enable the Council of the College to provide for the Departments of Chemistry and Physics in the same block. The building will be the first contribution to the University building scheme, and will be a considerable relief to the growing congestion in the present buildings.

THE Air Ministry announces that six hundred aircraft apprentices, between fifteen and seventeen years of age, are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks, and at Flowerdown, near Winchester. They will be enlisted as the result of an open competition and of a limited competition held by the Civil Service Commissioners and the Air Ministry respectively. The apprentices are given a thorough training in their trade by qualified technical instructors, and their general education is also carried on simultaneously by a staff of graduate teachers. Further information can be obtained on application to the Royal Air Force, Gwydyr House, Whitehall, London, S.W.1.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to senior studentships and overseas science research scholarships for 1928:—*Senior Studentships*: Dr. T. E. Allibone, for research in pure and applied physics, and Mr. L. S. B. Leakey, for research in archæology and physical anthropology, on the recommendation of the University of Cambridge. Dr. G. F. J. Temple, for research in mathematics and mathematical physics, on the recommendation of the Imperial College of Science and Technology. Mr. B. Cavanagh, for research in physical and analytical chemistry, on the recommendation of the Victoria University of Manchester. Mr. C. E. Wynn-Williams, for research in experimental physics, on the recommendation of the University College of North Wales, Bangor. *Overseas Science Research Scholarships*: Canada, Mabel A. Borden (Dalhousie—zoology), D. R. McCullagh (Manitoba—biochemistry), and B. W. Sargent (Queen's, Ont.—physics); Australia, H. C. Webster (Melbourne—physics) and J. D. M'Gee (Sydney—physics); New Zealand, W. A. Macky (New Zealand—physics); South Africa, Evlyn Boyd (South Africa—zoology); Irish Free State, H. S. Boyd Barrett (National University — organic chemistry).

THE first Pan-Pacific Conference on Education, Reclamation, and Recreation, called by the President of the United States, was held at Honolulu on April 11–16, 1927. The United States Department of the Interior has now published a full report of the proceedings. In addition to the United States, represented by the Secretary of the Interior, the Commissioner of Education, and 25 other officials of various departments, the following countries were represented by official delegates: Australia (5), Fiji Islands and Western Pacific, Great Britain (British Consul at Honolulu), New Zealand, Chile, Peru (2), Colombia, Mexico (3), Nicaragua, France, Japan (9). There were no representatives of Canada, China, India, Siam, or the Dutch East Indies. Opportunities for the establishment of friendly personal relations were amply provided by giving up to excursions and social functions the week preceding and half of the week following the actual sessions of the conference. The addresses and discussions contain much of educational and scientific interest relating to the following, among other topics: the educational systems of the United States, Australia, Japan, Mexico, New Zealand, Peru, Hawaii, and American Samoa; exchange of lecturers, teachers, students, research workers, etc.; centres of educational information; evaluation of student credentials; vocational education; infant and child welfare; conservation and use of water; land-settlement; opportunities for scientific research and education presented by national parks; the uses of museums; wild life conservation; bird-migration. Resolutions adopted for submission to the various interested governments dealt with [illegible]ls for introducing into the curricula of [illegible] schools courses in maternal and child [illegible] inv[illegible]ing the attention of government edu[illegible]fficials to the desirability of uniformity in educati[illegible] terminology, and the appointment by the several governments of a pan-Pacific committee on co-operation between museums with special reference to the exchange of personnel, research students, publications and exhibits, and co-operation in exploration and scientific research. It was suggested that another conference should be held within two years.

Calendar of Customs and Festivals.

July 16.

ST. BRECCAN of Cluain-Catha (sixth and seventh centuries), of the race of Eoghan, son of Niall. Cluain-Catha is therefore identified with Cloncha or Clonca, Co. Donegal. The saint is said to have been the Abbot of Moville or Magh-bile, a foundation dating from St. Patrick's time, in Co. Donegal, and Bishop of Ardmore, Co. Meath. The obscurity and lack of precision of his legend suggest the survival of a pre-Christian cult, a suggestion which is supported by the pilgrimages to a pool in the rocks near Malin Head for the cure of various diseases, and prehistoric monuments near the ruined abbey—a curious stone circle, and what is known as Ossian's Grave. The name Magh-bile, which means "The Place of the Sacred Trees," shows that it was at one time the site of a sacred grove of the earlier faith.

July 17.

ST. KENELM'S DAY.—An annual fair was held on July 17 at Clent, in the parish of Hales Owen, in the field in which was situated the chapel of St. Kenelm. It arose out of a large concourse of people who were accustomed to assemble at the shrine on this day. The fair, at which the principal article of merchandise was cheese, was of considerable antiquity. It is probable, therefore, that, as in other cases, it perpetuated an assembly at a spot regarded as a place of sanctity long before it was associated with the saint. This view is supported by an annual custom, recorded by Brand, which was known as 'crabbing the parson.' On St. Kenelm's Wake, held on the Sunday after the fair, the clergyman of the parish on his way to conduct service was pelted with crabs as he went through the church field. According to another version, the inhabitants pelted one another with crabs, the pelting of the clergyman being incidental only while he was proceeding to the church.

July 18.

ST. THENNA, THENOG, or THANAW, of Glasgow (fifth and sixth centuries). A saint of obscure history reputed to be the mother of St. Kentigern, founder and patron of Glasgow. The story of St. Kentigern is largely legendary, and in so far that saint is identified with a Celtic god. It is therefore not surprising to find, as in the story of Merlin, that he was the son of an unknown, or, possibly in the original form of the legend, of no human father. According to one version, his mother was subjected to violation. Another story is that on Thenna's refusal to marry Ewen, son of Urien Rheged, King of Cumbria, her father, King of Laudonia of Scotia, gave her to a herdsman, who, however, in secret was a Christian, and with whom she lived inviolate. Before the birth of Kentigern she was sentenced by her father to be cast down a steep rock called Kep Duff, said to be Lammermoor, a statement which may preserve a record of a form of sacrifice similar to that to which reference is made in stories of Buddhist women of India. She was miraculously preserved from death, however, and cast ashore on the coast of Fife. She was again put to sea in a boat by a chieftain and reached Culross, where she gave birth to her son in a cave, near the cave of St. Servan.

July 20.

ST. MARGARET'S DAY.—A virgin and martyr whose cult spread widely over England, France, and Germany in the eleventh century. Her shrine in Paris was much frequented by women who desired children, a vestige of a pagan cult associated also with other Christian saints. At Bassingbourne, in Cambridgeshire, a festival of some importance took place on this day. In 1511 the miracle play of the Holy Martyr St. George was acted on an open stage in a field, and the churchwardens' accounts show that other parishes and townships took part in providing the expenses. A minstrel and waits were hired from Cambridge, and the keep of the players was provided for several days.

A well of St. Margaret at Wereham Church, Norfolk, was at one time much frequented, when people regaled themselves with ale and cakes, music and dancing. "Alms were given and offerings and vows made."

Of St. Margaret herself, the legend runs that she was once swallowed whole by the Devil, but that on making the sign of the cross she issued sound and whole. On another occasion when the Devil appeared to her she overcame him, placing her foot upon his neck, whereupon he confessed that he was Veltis, one of the devils enclosed by Solomon in a brass bottle and released at Babylon.

July 21.

ST. VICTOR of Marseilles.—The Abbey of St. Victor, founded by St. Cassion, patriarch of Constantinople, in the fourth or fifth century, stood upon ground held specially sacred by the people of Marseilles, as there was situated the grotto to which St. Mary Magdalene was said to have retired on landing at Marseilles. A chapel was afterwards erected on this spot and named "Notre Dame de la Confession," but by a popular confusion the chapel was held sacred to the Virgin. It is evident that there must have been a number of these sacred grottoes in the neighbourhood of Marseilles, for St. Mary Magdalene is reputed to have withdrawn again a league from Marseilles to a spot where a monastery of Carmes was afterwards founded, and later to Sainte Beaume, a grotto in the mountain of St. Pilon, where she ended her days.

The association of deities, and especially female deities, with caves and grottoes is familiar in the European pagan religions and folklore. The relics of St. Victor himself, which were preserved in the monastery bearing his name, were associated with many miracles, but especially the cure of demoniacs. He is said, when armed *cap-à-pie* and mounted, to have conquered the dragon of the wood adjoining, and a sculpture bearing a close resemblance to the familiar effigy of St. George was carved over the porch of the church.

St. Victor's day was formerly celebrated at Marseilles by a procession known as 'La Triomphale,' when the relics of the saint were carried round the town by the prior of the monastery, attended by the whole community, the procession being headed by a cavalier completely armed.

That the district was of special sanctity in early times is shown by the number of beliefs and practices which long survived. No woman could enter the grotto shrine of St. Mary Magdalene without being struck blind. The notorious Queen Joan disregarded the prohibition, and suffered the penalty immediately on passing the portal. Her sight was restored only when she had placed a rail of solid silver around the image of the saint. No woman was ever allowed to enter the underground chambers or grottoes in which the rites of Mithra were performed. The marble tomb of Mary Magdalene bore witness to the memory of the varied traditions of the district of Marseilles. On it were many curious figures, and among them the wolf suckling two children. One of two small columns of granite at the well of St. Victor in the Abbey bore an imprint of the devil's claw—in reality a partially defaced acanthus leaf, dating from the previous use of the column.

Societies and Academies.

LONDON.

Royal Society, June 28.—E. Jones: Photographic study of detonation in solid explosives. Direct photography of a detonating cartridge possesses advantages over other methods for determining rates of detonation in that it is absolute and enables a continuous and permanent record of the progress of detonation to be obtained. Results are given to illustrate the two stable velocities of detonation peculiar to gelatinous explosives, and the effect of nitroglycerine content of a powder explosive on its velocity of detonation. Photographic records obtained with opaque explosives give the rate of propagation of detonation along the surface of the cartridge. The detonation front inside the cartridge is convex towards the undetonated portion, so that detonation is further advanced on the axis of the cartridge than on the surface. For one explosive, the stable form assumed by the detonation front inside the cartridge, and its effect on duration of detonation phenomenon over a plane transverse section of the cartridge, have been determined.

E. T. Whittaker: On the potential of the electromagnetic phenomena in a gravitational field. In classical electromagnetic theory, the electromagnetic field due to any number of electrons moving in any manner is determined by a theorem which expresses the scalar and vector potentials of the field in terms of the positions and velocities of the electrons. This theorem is extended to electromagnetic phenomena which take place in a gravitational field, so that the metric of space-time depends on the gravitating masses. The formula obtained is completely different from the well-known formula of classical electromagnetic theory, of which it is, nevertheless, the true generalisation.

B. Topley and J. Hume: The kinetics of the decomposition of calcium carbonate hexahydrate. Measurements have been made under controlled conditions of the rate of the reaction $CaCO_3 . 6H_2O = CaCO_3 + 6H_2O$, the substance being in contact with water in a dilatometer. The very large increase in velocity is due to a true temperature coefficient of reaction rate. The absolute rate of propagation of chemical change in the solid has been deduced, and the temperature coefficient has been measured over the range 0° to 15°. An attempt is made to relate together the absolute reaction rate and its temperature coefficient by means of a mechanism involving the vibration frequency of the ions in the interface between the two solid phases and the distribution of energy among the vibrating ions.

L. W. Nordheim: On the kinetic method in the new statistics and its application in the electron theory of conductivity. With proper definitions, the dynamical theory can be worked out both for the Einstein-Bose and the Fermi-Dirac statistics in just the same way as by Boltzmann for classical statistics. The modified form of the fundamental equation of the gas theory is given, and the equilibrium states and the H-theorem are deduced from it. In comparison with the classical theory some characteristic new terms occur, but in the case of the electron theory of conductivity, they just cancel out in the usual approximation owing to the large mass ratio of the electrons and the atoms. It is therefore justified in that special case to use the new distribution laws together with the old form of the fundamental equation.

R. W. Wood and V. Voss: The fluorescence of mercury vapour. The factors determining the fluorescence of mercury vapour excited by the aluminium spark have been determined. Very minute traces of water-vapour destroy the fluorescence. All the stronger atomic lines of mercury have been found in the fluorescence spectrum, in addition to bands due to the mercury molecule. The intensity of these lines is proportional to the square of the intensity of the exciting light (the 2536 line excepted). Bands due to mercury hydride have been observed in the spectrum, as well as the carbon line 2478.

E. Rudberg: The velocity distribution of photo-electrons by soft X rays. By means of a special magnetic method, measurements are obtained of the velocity distribution in the photoelectric emission from targets of carbon, aluminium, copper, and silver produced by the soft X-radiation from a carbon anode. In all cases, the emission is constituted of a group of electrons of a few volts energy and a less prominent group with energy concentrated in the region 200–280 volts. Baking at 400° C. generally reduces the first group by about 50 per cent, but does not affect the second. The latter seems to consist of primary electrons directly produced by the incident radiation quanta, chiefly belonging to the carbon $K\alpha$ line (275 volts). The distribution in the first group is identical with that of the secondary emission produced by electron bombardment; it is inferred that this group results from the presence of fast primary electrons in the target. Preliminary experiments on gold leaf indicate an absorption coefficient of about 3×10^5 cm.$^{-1}$

P. Götz and G. M. B. Dobson: Observations on the height of the ozone in the upper atmosphere. Some fifty measurements have been made of the height of the ozone layer in the upper atmosphere over Arosa (Switzerland). It is greatest when the amount of ozone is large, and least when the amount is small, and there is also evidence of an increase of height from autumn to spring. The average height seems to be between 35 km. and 40 km.

T. M. Lowry and M. A. Vernon: An improved method of ultra-violet polarimetry: anomalous rotatory dispersion of sodium tartrate. Improved sensitiveness has been obtained by measuring with a densimeter the density of the photographic image of the middle and outer portions of a triple field. By plotting the ratio of the densities against the readings of the analyser scale, the setting which gives equal photographic densities can be read off within about 0·005°. In this way a curve of anomalous rotatory dispersion has been plotted for a 1 per cent solution of sodium tartrate, which gave a maximum dextrorotation of only 0·5°.

J. B. Cohen, C. H. Browning, S. Ellingworth, and R. Gulbransen: Antiseptic compounds: some further derivatives of anil-quinoline. Compounds of larger molecular weight have been prepared and tested. Owing to limitations of solubility, no great increase in mass of the quinoline portion of molecule was possible, but powerful antiseptics were obtained by condensation of various nitroso compounds with methochlorides of methyl and ethyl quinaldyl carbamates. Addition of further aromatic nuclei to the benzene portion of the molecule diminishes antiseptic potency, but where the additional nucleus is reduced, thus assuming an aliphatic nature, activity is greater. Particularly potent substances are obtained by condensation of nitroso derivatives of tetrahydro-quinoline and methyl tetrahydro-quinoline with quinaldine compounds. Products were also prepared from nitroso mono-methyl aniline, practically as active as the corresponding dimethylamino compounds, whereas primary amino derivatives are less potent. Thus in the anil-quinoline series, the distinction appears to lie between those substances containing, on one hand,

a primary basic group, and, on the other, a secondary or tertiary group, in the benzene nucleus.

R. J. Ludford: Vital staining of normal and malignant cells (1). Vital staining with trypan blue and the cytoplasmic inclusions of liver and kidney cells. By the cytological technique described it is possible to demonstrate in kidney and liver cells of animals stained intravitally with trypan blue: (*a*) Dye droplets and mitochondria; (*b*) dye droplets and Golgi apparatus. No definite relation can be established between dye droplets and mitochondria. The dye droplets make their appearance in relation to the Golgi, and when formed break away from it. The formation of the droplets resembles the formation of secretion granules in gland cells. The observations suggest a functional inter-relation between the Golgi apparatus and the mitochondria.

E. D. Denny-Brown: Inhibition as a reflex accompaniment of the tendon-jerk and of other forms of muscular response. Close examination of cessation of tonic posture action currents during a tendon jerk in the same muscle reveals that the cessation is an inhibition. The silence is found by analysis to be due in part to a refractory period of the motor units involved, combined with a proprioceptive reflex inhibition of all units of the centre, caused by stimulation of some end organ in the muscle by the motor excitation. There is reason to believe that this end organ is the muscle spindle, and that every reflex activation evokes a proprioceptive inhibitory effect upon the muscle.

Physical Society, June 8.—L. F. Richardson and students of Westminster Training College: Contact potential in the Dolezalek electrometer connected idiostatically. The deflection x was related to the voltage V by the formula $x = k\{\frac{1}{2}V^2 + \eta V\}$, k being constant from month to month, but η varying from 0·3 to 1·2 volts on different days. If it is desired to measure V, it is therefore essential to reverse the polarity in order to eliminate η.—G. P. Barnard: Some experiments on the light-sensitivity of commercial selenium cells. Part 1.—The relation connecting the change in conductivity of selenium cells with illumination. The change in conductivity C due to a given intensity of illumination I is proportional to some power of the illumination I—*i.e.* $C \propto I^x$. The index value x varies from cell to cell, and is probably dependent on the construction of the cell. Part 2.—The reaction of selenium to various spectral regions. The change in conductivity of selenium cells is dependent, not on the number of foot-candles incident on the cell, but rather on the amount of radiant energy received. For the same amount of energy received, the action of the infra-red is relatively much weaker than that of the shorter wave portion of the spectrum. Experiments on the decay of conductivity of selenium after exposure to radiation from various portions of the visible spectrum indicate that, throughout a large portion of the visible spectrum, the internal state of the selenium, as determined by the change in conductivity, is independent of the wave-length of the exciting radiation.—J. R. I. Hepburn: The vapour pressure of water over sulphuric acid–water mixtures at 25° C., and its measurement by an improved dew-point apparatus. A critical study has been made of data previously used by Wilson in the construction of a mean curve for the vapour pressure of water over sulphuric acid–water mixtures at 25° C. The observations of Sorel (employed by Wilson over the concentration range 44–82 per cent sulphuric acid) are shown to be probably inaccurate, by calculations based on thermodynamics, and by determinations at 25° C., using an improved dew-point apparatus.

Mineralogical Society, June 12.—F. Slavík and L. J. Spencer: Place-names of mineral localities in central Europe. Many important mining districts in the former Austro-Hungarian monarchy are now in other countries and the localities are now known officially by other names. Lists are given for each county and province, with equivalent place-names in the various languages (fifteen in all), together with a statement of the principal minerals from each locality. A key to the pronunciation of letters, with diacritical marks and also a glossary of geographical terms that enter into the construction of place-names are added.—L. J. Spencer: Eleventh list of new mineral names. The first list of this series was published in 1897 and gave all the names of minerals not in the sixth edition of Dana's "System of Mineralogy" (1892). Others have appeared every three years at the end of each volume of the *Mineralogical Magazine*. They are intended as dictionary lists of new names rather than lists of new minerals. About 170 names are now added.—A. F. Hallimond: On the atomic volume relations in certain isomorphous series (3). It has already been shown that the volume differences in isomorphous series derived from the same group of eutropic elements stand in a constant ratio in all series, and that this relation can be used to calculate atomic volumes for the elements in the combined state. It is now shown that compressibilities agreeing with those determined by Slater for eleven alkali halides can be calculated from the atomic volumes already assigned to the combined elements, by means of the relations $\beta = V/K$, $\beta' = V'/K'$, where β, V are the compressibilities and atomic volumes of the combined metals; β', V' those of the halogens. For all the metals, K has the value $= 4 \times 10^{-6}$; for the halogens K' is approximately $2 \cdot 5 \cdot 10^{-6}$. The compressibilities of the free metals, as well as the atomic volume relations and the compressibilities in the combined state, are consistent with relations of the type $pv = K$, already indicated by Richards for the free metals; K, the constant for the eutropic group, assuming a new value in each isomorphous salt-series. The atoms thus behave as regions of a perfect gas under a high pressure.—H. Collingridge: On the determination of optic axial angles and crystal-forms from observations by the Becke method in thin sections. A suggested method of combining separate observations of different sections in one stereographic diagram and incidentally finding from the combined diagram the forms and axial ratios and optic axial angle of the crystal. The method is illustrated by an example of olivine in an olivine-basalt.—S. I. Tomkeieff: A contribution to the petrology of the Whin Sill. Certain rare varieties of the Whin Sill are described, such as the coarse gabbroidal rock, occurring in the form of bands within the mass of the normal dolerite, the coarse rock with red granophyric spots, the red felsitic veinlets, and spherical aplitic inclusions. A scheme of differentiation is applied to explain the origin of these varieties.

Geological Society, June 13.—G. B. Barbour: A re-excavated Cretaceous valley on the Mongolian border. The valley, originally cut in pre-Cretaceous lavas, was completely filled by the Nantienmen Beds, levelled off by erosion, and entirely covered by a heavy capping of plateau-basalts. During late Pliocene times a stream followed part of this old Mesozoic valley-axis. The valley bottom was again filled up by wind-blown loess in mid-Pleistocene times, again partly excavated in late Pleistocene, and once more filled with very late Pleistocene or early recent gravels. At present, the course is being opened for the fourth time. The

Cretaceous valley deposit (Nantienmen Beds) has been left clinging to the side-walls in many places.—S. I. Tomkeieff: The volcanic complex of Calton Hill (Derbyshire): a petrological study. There are two phases of vulcanicity:—(i) Effusive phase—represented by, besides the agglomerate and tuff of the old volcanic cone, a highly decomposed lava. Petrologically and chemically it is comparable with the other contemporaneous Lower Carboniferous lavas of ne district. The vesicles are filled up with a chlorite f delessite type. (ii) Intrusive phase—represented y a fresh analcite-basalt, which has intruded into he old volcanic chimney and spread amœba-like in he volcanic cone, detaching large masses of vesicular ava.

CAMBRIDGE.

Philosophical Society, May 21.—**A. G. Hutchison**: 'he metamorphic history of the Dee-side limestone, .berdeenshire. The metamorphic history can be ivided into three episodes: (*a*) Regional (of the ighest grade) characterised in the limestone by iopside-hornblende epidotezoisite and scapolite, and n the Older Granite intrusions by hornblende pegnatites. (*b*) Thermal by Newer Granites, char.cterised by wollastonite-grossularite-idocrase hornelses, chiefly confined to the neighbourhood of the ochnager granite mass. (*c*) Post-thermal emanations rom the Newer Granites, chiefly the Lochnager and Birsemore, resulting mainly in a widespread developnent of prehnite and, to a less extent, in wollastonite, rossularite, idocrase, scapolite.—**L. R. Wager**: The nechanism of replacement as illustrated by metaomatic alteration of the Whin Sill. A steady change n composition, by diffusion through small openings n the rock, of the solution responsible for the metaomatism, is used to explain a gradual transition from ltered to unaltered dolerite and to show that plagiolase, orthoclase, and other minerals are in equilibrium with aqueous solutions at the low temperature of the netasomatism.—**W. A. Wooster**: Demonstrations on piezo-electric effects. The alternating electric field which may be obtained from a suitable circuit containing a triode valve has been applied to the detection of piezo-electricity in crystal grains. When these are placed between the plates of a condenser included n the oscillatory circuit and the frequency of the atter continuously varied, large changes in the anode current occur at the resonance frequency of each crystal grain.—**J. D. Bernal**: An X-ray photo goniometer. The description of a new universal instrument for all forms of X-ray crystallographic and spectrometric work by photographic methods. The apparatus can be used (1) as an optical goniometer; (2) for rotating crystal photographs with (*a*) plane plate, (*b*) cylindrical camera; (3) for oscillating crystal photographs; (4) for Debye-Scherrer powder photographs; (5) as an X-ray spectrometer.

DUBLIN.

Royal Irish Academy, June 11.—**J. K. Charlesworth**: Glacial geology of North Mayo and West Sligo. During the Glacial period, North Mayo and West Sligo were completely overwhelmed by extraneous ice which proceeded north-westerly from the icecentres in Leitrim and Connemara. This is shown the striæ, dispersal of erratics, and the distribution of the moraines. The ice, on its retreat, uncovered the higher mountains, as the Ox Mountains nd the Nephin Beg range, and with the steady nlargement of these nunataks dissolved into valley glaciers. The various phases in the break-up of the ... and its complete withdrawal from the area can readily followed by the well-developed and abundant moraines and the marginal drainage features. Local glaciers associated with the highest corries came into existence at an early phase of the recession; they cover an area of but a few square miles, and correspond to a snowline of about 1000 feet on north and east slopes.

EDINBURGH.

Royal Society, June 4.—**G. Leslie Purser**: *Calamoichthys calabaricus*, J. A. Smith (Part 1): The alimentary and respiratory systems, concluded. The histology of the mucous membrane of the alimentary tract is extremely uniform, and, though their size and proportions vary in the different organs, the cells are only of three kinds, (*a*) cells forming digestive granules (scarcely to be found in œsophagus), (*b*), goblet cells secreting various mucoid substances, and (*c*), the ordinary columnar ciliated cells. These latter lose their cilia in the cul-de-sac, in the fundus of the œsogaster, which is much more muscular than any other part of the tract other than the pyloric region. In fact there appears to be an inverse relation between the ciliation and the musculature along most of the canal. There is a well-developed spiral valve in the first two-thirds of the intestine, but the histology is so similar throughout that no subdivision other than a purely topographical one is justifiable.—**P. R. C. Macfarlane**: Salmon (*Salmo salar*) of the River Moisie (E. Canada), 1926 and 1927. This report, the third of a series dealing with Moisie salmon, is based on a collection of 900 scale samples taken during the months of June and July in 1926 and 1927. As in the two previous investigations, the outstanding features are the large proportion of 'spring' fish, the high percentage of fish on their second or subsequent return to the river for spawning purposes, and the absence of grilse. Smolt ages vary from two to five years; the two- and three-years-old smolts, in practically equal proportions, together form 97 per cent of each year's collection, the remainder being four-years-old smolts, with one exception, which had spent five years of river life before migrating to the sea. The average weight and length of each age group, except in the case of the two + winters fish, are very similar to those found in Scottish collections. It is possible, however, that the main run of summer fish in the Moisie occurs after the sampling ceased in July. The figures obtained for 'condition,' the relationship between weight and length, corroborate the findings of the former investigations in that spring fish are in better condition than summer fish, the reverse of that found in the Rivers Dee and Spey in Scotland.—**R. A. Sampson**: The present-day performance of clocks. A study of the actual performance of two of the clocks at the Royal Observatory, Edinburgh, Shortt No. 0 and Shortt No. 4, during 1927. The clocks are at constant temperature as well as constant pressure, the arc is read daily to 2″, and besides transit circle determinations the two clocks are compared with one another by an oscillograph daily to $\frac{1}{1000}$ sec. Shortt No. 4 showed an increase in the pendulum of 0.012μ per day. Allowing for this, the rate was reasonably constant, showing only fluctuations in accumulated error which reached 0·1 sec. five times and once exceeded this. Reason is given to attribute this to residual escapement error.

PARIS.

Academy of Sciences, June 4.—**E. Goursat**: A problem of Monge with several independent variables.—**A. Mesnager**: A rectangular specimen undergoing normal pressures on its bases.—**A. Cotton**: Remarks concerning the note of MM. Cabannes and Daure on molecular diffusion.—**Ch. Gravier** and **J. L. Dantan**: Some points of the biology of the polychætal annelids of the *Nereis* family.—**Gabriel Bertrand** and **Hirosi**

Nakamura : The importance of manganese for animals. Description of feeding experiments with mice. Manganese would appear to take part in the whole of the nutritive exchanges in animals.—**P. Helbronner** : Deviations from the vertical in the French Alps. Figures for the astronomical latitude minus the geodesic latitude and astronomical longitude minus the geodesic longitude are given for eight stations between the Lake of Geneva and the Mediterranean.—**André Blondel** : The measurement of the brightness of diffusing surfaces.—**Georges Claude and Paul Boucherot** : The utilisation of the thermal energy of the sea. A description, with diagram, of the experimental installation at Ougrée.—**H. Le Chatelier** : Remarks on the preceding communication. The 50 kilowatt machine was worked by a heat engine with a temperature range of 10° C. only, an achievement hitherto regarded as impossible.—**Jean Baptiste Senderens and Jean Aboulenc** : The action of sulphuric acid on the aromatic acids : the sulpho-aromatic acids.—**E. Mathias** : Magnetic measurements in Creuse, Dordogne and Haute-Vienne.—**G. Rempp** : The comparison of meteorological results and the effects of chance. A development of results obtained by L. Besson and proof of their generality.—**J. Popken** : The arithmetical nature of the number *e*.—**V. Hlavatý** : The second fundamental form relative to the torsion factor. **Rèmes** : The solutions of differential equations, considered as functions of the initial point.—**J. Delsarte** : A group of functional rotations with one parameter and the connected functional differential equations.—**Maurice Thomas** : A new arrangement utilising, without a fall, liquid or gaseous currents, as well as waves.—**Louis Breguet** : Landing of aeroplanes and brake power. A discussion of the effects of various types of brake with special reference to safety of landing.—**Carl A. Garabedian** : Circular and rectangular thick plates loaded at the centre.—**P. Swings** : The relations between the Riemann potentials and differential quadratic forms of stationary fields with spherical symmetry.—**Seth B. Nicholson and Nicolas G. Perrakis** : The spectroscopic proof of the presence of boron in the sun. A direct comparison was made of the region λ4645-5137 of the arc spectrum of boric acid with the same region of the sunspot spectrum, the latter obtained with the 75-feet spectrograph of the large telescope of Mount Wilson Observatory. 81 strong lines were measured, but 55 of these could not be used, either because of the neighbourhood of a strong line showing the Zeeman effect or of other strong lines. Of the remaining 26 lines, 25 were identified.—**A. Danjon** : A visual stellar photometer.—**Frédéric Joliot** : The resistivity of thin metallic layers obtained by cathodic pulverisation.—**Soulié** : An arrangement permitting the maintenance of a constant potential feeding a receiver branched on an alternating current network.—**S. Pieńkowski** : The fluorescence of mercury vapour excited electrically.—**J. Cabannes and P. Daure** : Spectroscopic analysis of the light obtained by molecular diffusion of a monochromatic radiation in the middle of a fluid.—**Jean J. Trillat** : Spectrographic researches on beating out thin sheet metal. X-ray spectrography has been applied to the study of the changes produced in the structure.—**L. Andrieux** : The preparation by electrolysis of the borides of calcium, strontium, and barium. These borides can be obtained by the electrolysis at 1000° C. of a mixture of calcium (strontium or barium) borate with the corresponding fluoride. Analysis showed them to be of the composition $Ca(Sr,Ba)B_6$.—**Paul Bary** : The formation of filaments of ferric oxide by drying colloidal solutions.—**Maurice Aumeras** : The solubility of cadmium sulphide in hydrochloric acid. The experimental results were in agreement with the formula deduced from the application of the ionic hypothesis and the law of mass action, assuming that hydrogen sulphide dissociates into HS and $\overset{+}{H}$.—**Paul Riou and Léon Lortie** : The influence of some colloidal substances on the velocity of absorption of carbon dioxide by solutions of neutral sodium carbonate.—**P. Job** : Application of the spectrographic method and the spectrophotometric method to the study of the hydrolysis of some alkaline salts.—**Mlle. Choucroun** : The selective permeability of membranes. The influence of the mobility of the ions on the polarisation.—**Robert F. Le Guyon and Roger F. Auriol** : The microtitration of lead cations and chromic ions by the centrifugal volumetric method. This method, described in an earlier communication, gives exact results in the titration of lead by a chromate. It may be useful for the estimation of lead in biological chemistry and in blood and urine.—**P. Brenans and Ch. Girod** : Chloriodophenols obtained from 5-chloro- and 3, 5-dichlorosalicylic acids.—**A. Wahl and J. P. Sisley** : Improvements in the method of elementary organic analysis. By reducing the quantity of material taken for combustion to 80-100 milligrams, a shorter combustion tube may be employed and the operation can be completed in 25-45 minutes.—**André Léauté and Georges Dupont** : A method for the partial dehydrogenation of certain hydrocarbons to render them more suitable for use in briquetting coal. It is possible partially to remove hydrogen from tar or oil by heating to a moderate temperature with sulphur. The viscosity and agglutinating power of the oil are increased, and the amount of sulphur remaining in the oil is not high enough to interfere with its application to briquetting.—**Jacques de Lapparent** : Mineralogical knowledge of the Pays de Fenouillet bauxites.—**Mihaïlovitch Jélénko** : The great earthquakes in Bulgaria in 1928.—**L. Aufrère** : The relations between the cold currents, oceanic absence of rain, insular deserts, and coast deserts in tropical and subtropical regions.—**C. Dauzère and J. Bouget** : The influence of the geological constitution of the soil and the points struck by lightning. The position of places liable to be struck by lightning is partly determined by the geological constitution of the soil. Some examples are given.—**G. Nadson and G. Philippov** : The formation of new stable races in the lower fungi under the influence of the X-rays.—**Roger Heim** : Preliminary observations on the genus *Inocybe*.—**Georges Nichita** : The pseudobranchia of *Girardinus Guppyi*.—**Béhague, Garsaux, and Ch. Richet, Jr.** : The minimum oxygen pressure compatible with life. The absolute pressure of the oxygen is not the only element which governs the respiratory life of animals.—**Mlle. Andrée Courtois** : Variations in the proportion of amino-acids of some Lepidoptera during nymphosis.—**P. Bourcet and A. Fourton** : The chemical nature of digitalic acid. The various substances described under this name are merely succinic acid containing more or less impurities.—**Mlle. Suzanne Ancel** : The action of various gases on the egg of the fowl. Assimilation of carbon monoxide as an inert gas. Eggs kept for eight days in an inert atmosphere of nitrogen or of hydrogen afterwards develop in the normal manner. Abnormal development occurs after exposure to sulphur dioxide, ammonia, hydrogen chloride, chlorine, acetylene, carbon dioxide, or coal gas. After eight days in carbon monoxide the eggs develop normally. Hence carbon monoxide behaves as an inert and not as a toxic gas.—**R. Coquoin** : The method of determination of the respiratory elimination of acetone in man.—**A. Philibert and J. Risler** : The bactericidal action of colouring matters.—**C. Levaditi and Mlle. R. Schoen** : The penetration and multiplication of protozoa in the nerve cell.

Official Publications Received.

BRITISH.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 21 and 22. 21: The Rejuvenation of the Champion Potato, by W. D. Davidson; 22: A Review of Literature dealing with the Degeneration of Varieties of the Potato, by W. D. Davidson. Pp. 319-339. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 4s.

Journal of the Indian Institute of Science. Vol. 11A, Part 5: The Dielectric Constants of Ammonia, Phosphine and Arsine. By H. E. Watson. Pp. 41-61. 1 rupee. Vol. 11A, Part 6: The Fermentation of Toddy and an Account of the Micro-Organisms producing It. By M. Damodaran. Pp. 63-74. 12 annas. (Bangalore.)

Worthing Archæological Society. Sixth Annual Report. Pp. 16. (Worthing: The Museum.)

Mines Department. Sixth Annual Report of the Safety in Mines Research Board, including a Report of matters dealt with by the Health Advisory Committee, 1927. Pp. 55. (London: H.M. Stationery Office.) 9d. net.

Review of Agricultural Operations in India, 1926–27. By Dr. D. Clouston. Pp. vi+158+7 plates. (Calcutta: Government of India Central Publication Branch.) 2 rupees; 3s. 6d.

Memoirs of the Department of Agriculture in India. Veterinary Series, Vol. 4, No. 1: The Chemotherapy of Surra (*Trypanosoma evansi* Infections) of Horses and Cattle in India. By Dr. J. T. Edwards. Pp. iii+100+26 plates. 4.2 rupees; 7s. Veterinary Series, Vol. 4, No. 3: Trypanblue and certain Dithio-aniline Derivatives; their Efficacy in the Treatment of Piroplasmosis and other Affections in the Central Provinces. By Major R. F. Stirling. Pp. ii+129-187. 8 annas; 4d. (Calcutta: Government of India Central Publication Branch.)

The Agricultural Department, Madras. Bulletin No. 90: The Malaria Problem and its Solution. By Rudolph D. Anstead. Pp. 80. (Madras: Government Press.) 2 annas.

The Physical Society. Proceedings, Vol. 40, Part 4, June 15. Pp. 159-228. (London: Fleetway Press, Ltd.) 7s. net.

Papers from the Geological Department, Glasgow University. Vol. 12 ...tavo Papers of 1927). Pp. viii+17 papers. (Glasgow: Jackson, ...lie and Co.)

FOREIGN.

...roceedings of the United States National Museum. Vol. 71, Art. 24: ...alogue of Human Crania in the United States National Museum ...ections; Australians, Tasmanians South African Bushmen, Hotten...and Negro. By Aleš Hrdlička. (No. 2686.) Pp. 140. Vol. 72, Art. ... Fossil and Recent Bryozoa of the Gulf of Mexico Region. By Ferdi...d Canu and Ray S. Bassler. (No. 2710.) Pp. 199+34 plates. Vol. ... Art. 18: Millipeds of the Order Colobognatha, with Descriptions of New Genera and Type Species, from Arizona and California. By ...F. Cook and H. F. Loomis. (No. 2714.) Pp. 26+2 plates. Vol. 72, ...24: Description of a New Species of Gecko from Tanganyika Terri...y, Africa. By Arthur Loveridge. (No. 2720.) Pp. 2+1 plate. ...shington, D.C.: Government Printing Office.)

...Series of Seven Radio Talks on Science in Industry (with Select ...iographies). Delivered by Dr. Edward R. Weidlein, Prof. Stephen L. ...Hale, Dr. James B. Garner, Frederick W. Sperr, Dr. Warren Fred ...gher, Dr. E. Ward Tillotson, Macdonald C. Booze, William A. Hamor. ...dio Publication No. 9.) Pp. 40. (Pittsburgh, Pa.: University of ...sburgh.) 60 cents.

...Series of Eleven Radio Talks on Science in the Home. By W. A. ...nor, E. R. Harding, R. R. Irvin, Dr. Donald K. Tressler, Dr. H. M. ...pson, R. H. Heilman, George H. Johnson, L. E. Jackson, Dr. O. F. ...enburg, Dr. F. F. Rupert, Carl H. Geister, Edgar S. Ross. (Radio ...lication No. 23.) Pp. 83. (Pittsburgh, Pa.: University of Pittsburgh.) ...nts.

...eries of Six Radio Talks on Automobile Engines: their Operation ...Care. By Dr. Philip K. Porter, Dr. Donald R. Stevens, Samuel P. ...ey, Dr. B. L. Souther, C. J. Livingstone. (Radio Publication No. ...) Pp. 51. (Pittsburgh, Pa.: University of Pittsburgh.) 60 cents.

...eries of Seven Radio Talks on Wearing Apparel: its Manufacture, ...y, Selection and Care. By Edgar R. Clark, C. F. Goldthwait, ...E. Jackson, George H. Johnson, Dr. Rob Roy McGregor, Helen E. ...ll. (Radio Publication No. 37.) Pp. 62. (Pittsburgh, Pa.: Uni... of Pittsburgh.) 50 cents.

...ods and Problems of Medical Education. (Ninth Series.) Pp. ... (New York City: The Rockefeller Foundation.)

...edings of the Academy of Natural Sciences of Philadelphia, Vol. ...e Alpine Algal Vegetation of the Mountains of British Columbia. ... Randolph Taylor. Pp. 45-114+plates 9-13. (Philadelphia, Pa.)

CATALOGUES.

...ection from the Catalogue of Medical Works. Pp. 8. Eighty-...ars, 1844–1928. Pp. 8. (London: H. K. Lewis and Co., Ltd.)

...matik, Physik, Chemie. Pp. 96. (Berlin: Verlag Julius Springer.)

...Cambridge Bulletin. No. 60, June. Pp. 28+8 plates. (Cam... At the University Press.)

Diary of Societies.

SATURDAY, JULY 14.

...ICAL SOCIETY (in Department of Physiology, University ...) at 3.15.—J. R. Marrach and L. F. Hewitt: Osmotic Pressure ... Albumin.—H. M. Vernon, T. Bedford, and C. G. Warner: The ...e of Various Systems of Artificial Heating on Skin Tempera... L. Dulière and H. V. Horton: Non-irritable Muscles.— ... and C. G. Imrie: The Influence of Thyroid in certain Types ...nuria.—C. G. Imrie: Blood Sugar and Hyperpnœa.—D. Denny Brown: Isometric Records of Contraction from the External Ocular Muscles.—D. Denny Brown and Sir C. S. Sherrington: Facilitation in the Flexion-Reflex.—S. Cooper: Arrangement of Fractional Contractions in Muscle.—J. F. Fulton: Changes in the Vascularity of the Human Occipital Cortex during Visual Effort.—J. Argyll Campbell: The Effects of Breathing Carbon Dioxide and Oxygen Mixtures upon the Carbon Dioxide and Oxygen Tensions in the Tissues.—J. Mellanby: The Action of Secretin on Plain Muscle.—W. Burridge: Note on Sweating.—J. B. S. Haldane: Pituitrin and the Chloride-Concentrating Power of the Kidneys.—F. M. T. Kerridge and F. R. Winton: The Hydrogen Ion Activity of the Isolated Uterus.—Demonstrations:—W. H. Wilson and M. Hammouda: Method of Investigating the Effects of Inflation and Deflation of the Lungs on the Respiratory Rhythm in Animals.—Dr. A. S. Parkes and G. F. Marrian: The Induction of Complete Growth of the Mammary Gland in the Non-pregnant Rabbit.—H. M. Carleton: Histological Changes in the Heart following Removal of the Fibrous Pericardium.—H. M. Carleton and D. T. Barnes: Radiographs of Cat's Heart after Removal of the Fibrous Pericardium.—S. Cooper and R. S. Creed: Extensor Reflexes in a Decerebrate Preparation.—D. Denny Brown and E. G. T. Liddell: The Tendon-Reflex.—D. Denny Brown: The Nerve-Endings in Striped Muscle.—J. F. Fulton and Sir C. S. Sherrington: Spinal Flexion-Reflex.—G. Ekehorn: A Method of Microtitration.

MONDAY, JULY 16.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (Annual General Meeting) (at Royal Society of Arts), at 5.30.—Addresses by The Earl of Balfour, Sir Robert S. Horne, Sir Martin Conway, and Prof. L. T. Hobhouse.

SATURDAY, JULY 21.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Ilfracombe), at 12.

CONFERENCES.

JULY 13, 14, AND 15.

MIND ASSOCIATION: ANNUAL MEETING AND JOINT SESSION WITH THE ARISTOTELIAN SOCIETY.

July 13.

At 5.—Mind Association (Annual Meeting) (at Clifton Hill House, Bristol), followed by a Joint Session with the Aristotelian Society, for which the following arrangements have been made:—

Friday, July 13.

At 8.—Chairman: Prof. J. A. Smith.—Address by Prof. G. C. Field.

Saturday, July 14.

At 10.—Chairman: Prof. Beatrice Edgell.—Symposium: The Nature of the Self and of Self-consciousness. Prof. G. Dawes Hicks, Prof. J. Laird, A. Dorward.

At 2.—Chairman: Prof. J. H. Muirhead.—Symposium: Bosanquet's Account of the General Will. A. D. Lindsay, Prof. H. J. Laski.

At 8.—Chairman: Prof. H. Wildon Carr.—Symposium: Time and Change. J. MacMurray, R. B. Braithwaite, Dr. C. D. Broad.

Sunday, July 15.

At 2.—Chairman: Prof. G. E. Moore.—Symposium: Is there a Moral End? Prof. J. L. Stocks, Prof. W. G. De Burgh, W. D. Ross.

At 8.—Chairman: Prof. T. P. Nunn.—Symposium: Materialism in the Light of Modern Scientific Thought. Prof. L. J. Russell, Miss L. S. Stebbing, Prof. A. E. Heath.

JULY 14-17.

INTERNATIONAL GEOGRAPHICAL CONGRESS (at London).

JULY 16-21.

ROYAL SANITARY INSTITUTE (at Plymouth).

JULY 17–20.

BRITISH EMPIRE CANCER CAMPAIGN.—International Conference.

Tuesday, July 17.

At 9.45 A.M. (at the Royal Society of Medicine).—Sir John Bland-Sutton: Address of Welcome.

At 10 A.M. (at Royal Society of Medicine).—The Relative Values of Surgery and Radiation in the Treatment of Cancer of the Cervix Uteri, Rectum, Breast and Buccal Cavity. Chairman: Sir John Bland-Sutton. General Opener: Prof. Regaud.—Cancer of the Cervix. Opener: Dr. M. Donaldson. Papers: Dr. Lacassagne, Sir Gilbert Barling, Bt.; Dr. Healey, Dr. Cheval, Dr. Zweifel, Dr. J. Muir, C. Berkeley.—Cancer of the Rectum. Opener: Sir Charles Gordon-Watson. Papers: Prof. Hartmann, W. E. Miles, J. P. Lockhart-Mummery, Dr. D. Quick, Dr. Neumann.

At 10 A.M. (at College of Nursing).—The Etiology of Cancer. Chairman: Lord Dawson of Penn. Opener: Prof. J. Ewing. Papers: Prof. Roussy; Prof. Blumenthal, Prof. Leitch, Prof. Borrel, Prof. Deelman, Dr. Murphy, Prof. Maisin, Prof. Rhoda Erdmann, Prof. J. McIntosh, Miss Maude Slye, Prof. Teutschlaender, Prof. Blair Bell, Prof. Leo Loeb.

Wednesday, July 18.

At 9.30 A.M. (at Royal Society of Medicine).—The Classification and Treatment of Bone Sarcoma. Chairman: Sir Charles Gordon-Watson. Opener: Prof. Ewing. Papers: W. S. Handley, Dr. W. B. Coley, J. Taylor, Dr. C. Simmonds, Prof. Fichera, Dr. F. Martin, R. C. Elmslie, Prof. M. J. Stewart, T. W. P. Lawrence.—Some Present Day Medical Aspects of Cancer. Chairman: Sir William Willcox.—Short Papers:—A Consideration of Cancer Cachexia, by Sir Thomas Horder. The Alleged Increased Frequency of Primary Carcinoma of the Lung,

by Dr. R. Hutchison, followed by Dr. L. S. T. Burrell, Prof. T. Shennan, Prof. J. S. Dunn, W. G. Barnard, and others.—Biological Effects of Radium and X-Rays, with Special Reference to the Factors of Wave-Length, Intensity of Radiation and Duration of Exposure. Chairman: Prof. Russ. Openers: Prof. Regaud, Prof. Holthusen, Dr. D. Quick.

(At College of Nursing).—Occupational Cancer. Chairman: Prof. W. S. L. Barlow. Openers: Prof. A. Leitch, D. J. C. Bridge and Dr. S. A. Henry, Dr. T. H. C. Stevenson. Papers: Prof. Schmorl, Dr. Rostoski, Dr. A. Scott, A. H. Southam, Dr. L. Carozzi, Dr. A. F. S. Sladden, Prof. Teutschlaender, Dr. W. J. O'Donovan, Dr. L. D. Savatard, Prof. W. M. de Vries, Dr. F. L. Hoffman, Dr. E. L. Kennaway, Prof. E. L. Collis.

Thursday, July 19.

9.30 A.M. (at Royal Society of Medicine).—The Relative Values of Surgery and Radiation in the Treatment of Cancer of the Cervix Uteri, Rectum, Breast and Buccal Cavity. Chairman: J. P. Lockhart-Mummery.—Cancer of the Breast. Opener: Prof. B. Lee. Papers: Prof. Jüngling, W. S. Handley, Dr. F. Martin, Dr. R. Knox, G. Keynes.—Cancer of the Buccal Cavity. Opener: Dr. D. Quick. Papers: S. Cade, Prof. Pfahler, D. Harmer, B. T. Rose.—Evaluation of Statistics relating to Effectiveness of Treatment. Opener: Dr. Janet E. Lane-Claypon. Papers: Dr. C. Wood, Prof. O. Winter.

(At College of Nursing).—Methods of Treatment by Chemo-Therapy, with special Reference to Lead. Chairman: Sir Thomas Horder. Opener: Prof. Blair Bell. Papers: Prof. C. Wood, Dr. B. Simpson, Prof. Dilling, Mr. Hume, Dr. Wyard, Dr. Loewy, Dr. A. F. Thomson, Dr. M. Copeman, Dr. Lumsden, Mr. Pybus, Prof Caspari, Dr. Hocking, Dr. H. J. B. Fry.

Friday, July 20.

9.30 A.M. (at Royal Society of Medicine).—The Early Recognition and Treatment of Cancer of the Stomach. Chairman: Sir Charles Gordon-Watson. Opener: Sir Berkeley Moynihan. Papers: Dr. E. Spriggs, Dr. A. F. Hurst, Prof. Stewart, Prof. Finsterer, Prof. D. Wilkie, Prof. Bastianelli, A. J. Walton, G. Taylor.—Diagnostic Methods in Relation to Cancer. Chairman: Sir William Hale-White. Opener: Sir Thomas Horder. Papers: Dr. T. Bennett, Dr. J. A. Ryle, Dr. MacCarty, Prof. Dudgeon, Prof. Ascoli, Dr. H. J. B Fry, Dr. G. A. B. Hicks, Prof. W. C. M. Lewis, Dr. S. Melville, Prof. Dodds, Sir William Willcox.—The Effects of Radium and X-Rays on the Blood Vascular and Lymphatic Systems, with Special Reference to Malignant Growths. Chairman: Dr R. Knox. Openers: Dr. F. C. Wood, Dr. A. Lacassagne, Prof. Holfelder.

(At College of Nursing).—Geographical and Racial Prevalence of Cancer. Chairman: Lt.-Col. F. E. Fremantle. Opener: Prof. Major Greenwood. Papers: Prof A. Niceforo, Dr. Sourasky, Dr. P. Stocks, Prof. Pittard, Dr. M. Young.—Public Action in Regard to Cancer. Opener. Sir George Buchanan. Papers: Prof. J. Maisin, Dr. G. A. Soper, Dr S. Reimann, Sir John Robertson, Prof. F. Blumenthal, Dr. R. V. Clark, Dr. C. K. Millard, Dr. W. A. Daley, A Cooke.

JULY 18-25.

INTERNATIONAL GEOGRAPHICAL CONGRESS (at Cambridge).

JULY 23-26.

BRITISH PHARMACEUTICAL CONFERENCE (at Cheltenham).

Monday, July 23.

Reception by the Mayor of Cheltenham.

Tuesday, July 24.

Welcome by the Mayor of Cheltenham.
Address by the Chairman of the Conference.
Science Meetings.
Delegates Meetings.

Wednesday, July 25.

Science Meetings.
Delegates Meeting.

Thursday, July 26.

Visit to Malvern.

JULY 24-27.

BRITISH MEDICAL ASSOCIATION (Annual Meeting, at Cardiff).

Provisional Programme.

Tuesday, July 24.

At 8 P.M.—Sir Ewen Maclean: Presidential Address.

Wednesday, July 25.

At 10 A.M.—Discussion: Diseases of the Coronary Arteries. Dr. G. A. Allan, Dr. A. G. Gibson, Dr. C. F. Coombs, Prof. G. Hadfield, Dr. C. B. Perry, Dr. I. J. Davies, Dr. D. E. Bedford, and Sir John Campbell.

Discussion: The Diagnosis and Treatment of Spinal Cord Tumours. D. J. Armour, Dr. G. Riddoch, Sir Percy Sargent, and G. Jefferson.

Discussion: Unsuccessful Forceps Cases. Prof. W. F. Shaw, Prof. J. Hendry, and Dr. D. A. Miller.—Paper: Prof. R. Vaudescal: Myomectomy during Pregnancy.

Discussion: Autotoxæmia as a Factor in the Causation of the Psychoses. Prof. W. Weygandt, Dr. E. Mapother, Dr. J. Porter-Phillips, Dr. Mary R. Barkas, Dr. A. Helen Boyle, Dr. D. F. Rambaut, Dr. F. A. Pickworth, and Dr. I. S. Wile.

Discussion: The Pathology of Encephalo-myelitis occurring in the course of Virus Disease and Exanthemata. Prof. H. M. Turnbull, Prof. J. McIntosh, Prof. J. C. G. Ledingham, Dr. M. H. Gordon, Dr. J. G. Greenfield, Dr. J. E. McCartney, Dr. S. P. Bedson, and Prof. G. Hadfield.

Discussion: Low Backache and Sciatica. W. A. Cochrane and P. J. Verrall.

Discussion: Chronic Splenomegaly in Childhood. Dr. R. Hutchison, L. E. Barrington-Ward, Dr. L. Findlay, and Dr. C. P. Lapage.

Discussion: Visual Efficiency and Working Ability. Dr. A. F. Fergus, Sir J. H. Parsons, and N. B. Harman.

Paper: Dr. T. H. Whittington: The Examination of the Eyes and Eyesight in Young Children.

Discussion: Chronic Ethmoiditis. Dr. R. Skillern and W. G. Howarth.

Papers: Dr. P. Watson-Williams: Case of Optic Neuritis due to Sphenoidal Sinusitis treated by Differential Exploration.—S. A. R. Wallace: The Ideal Treatment of Quinsy—Immediate Enucleation.

Discussion: The Relation between Trauma and Tuberculosis, especially from the point of view of Compensation and Accident Insurance. Dr. N. Tattersall, R. Milne, and Dr. O. May.

Papers on Factors in the Biochemistry of Tuberculosis: Dr. L. S. T. Burrell: The Therapeutic Value of the Heavy Metals.—Dr. J. C. Hoyle: The Serum Calcium in Experimental Tuberculosis.—Dr. W. H. Tytler: The Tuberculin-active Fraction of the Tubercle Bacillus.

Discussion: Ultra-violet Ray, and the General Public. Prof. W. E. Dixon and Dr. C. B. Heald.

Discussion: The Value of the Present Methods of Control of Infectious Diseases—(*a*) The Control of Small-pox. Dr. L. J. Rajchmann, Dr. J. M. Martin, Dr T. E. Hill, Dr. R. P. Garrow, Dr. R. B. Low, and Dr. C. K. Millard. (*b*) The Control of Scarlet Fever and Diphtheria. Dr. R. A. O'Brien, Dr. J. G. Forbes, Dr. B. A. I. Peters, and Dr. E. H. R. Harries.

Discussions: (1) Recent Advances in Diagnosis and Treatment of Human Helminthiasis. Lieut.-Colonel Clayton Lane. (2) Transmission of Kala-azar. Dr. C. M. Wenyon.

Discussion: Historical Aspects of Ideas regarding the Nature and Treatment of Dropsy. Dr. J. D. Comrie.

Papers: Dr. E. R. Williams: Welsh Physicians and the Renaissance.—Dr. J. D. Rolleston: The History of Scarlet Fever.—Dr. P. Diverres: The Welsh Physician in the Middle Ages.—C. J. S. Thompson: The History and Lore of Cinchona Bark.

Discussion: Recent Advances in the Medical Treatment of Gastric Diseases. Dr. A. F. Hurst and Dr. T. I. Bennett: Treatment by Diet and Drugs.

Thursday, July 26.

At 10 A.M.—Discussion: The Prevention and Treatment of Diphtheria. Dr. J. D. Rolleston, Dr. J. G. Forbes, Dr. E. W. Goodall, and Dr. J. McGarrity.

Discussion: The Diagnosis and Treatment of Sterility. Dr. A. E. Giles, Dr. S. Forsdike, and K. M. Walker.

Discussion: The Differential Diagnosis and Treatment of Cerebral States consequent upon Head Injuries. Dr. C. P. Symonds, Dr. C. Worster-Drought, W. Trotter, Dr. R. D. Gillespie, Dr. D. McAlpine, and Dr. G. Riddoch.

Discussion: Variations in the Intestinal Flora in Health and Chronic Disease. Prof. J. Cruickshank, Sir Thomas Horder, Bt., Sir Thomas Houston, Prof. J. H. Dible, Dr. A. F. S. Sladden, Dr. L. P. Garrod, and Dr. C. E. Dukes.

Discussion: Volkmann's Ischæmic Contracture, with special reference to Treatment. Sir Robert Jones, Bt., S. Middleton, and A. H. Todd.

Discussion: Chronic Nephritis in Childhood. Dr. J. C. Spence, Dr. H. T. Ashby, and Dr. N. B Capon.

Discussion: The Etiology of Glaucoma. W. S. Duke-Elder, T. Henderson, and N. B. Harman.

Paper: A. H. Levy: Telescopic Spectacles.

Discussion: Drainage of Brain Abscess. Sir Percy Sargent and S. R. Scott.

Paper: E. D. Davis: Injuries of the Ear arising from Fractures of the Skull.

Discussions: After-effects of Surgical Procedures on Cases of Pulmonary Tuberculosis. A. T. Edwards and Dr. F. G. Chandler. Tuberculosis as seen by the General Practitioner. Dr. R. Cameron and Dr. A. E. Kennedy.

Discussion: The Teaching of Hygiene. Dr. W. W. Jameson and Dr. H. B. Brackenbury.

At 10 A.M. to 12 NOON.—Discussion: The Fallacy of X-rays in Abdominal Diagnosis. H. J. Paterson, Dr. F. Hernaman-Johnson, and Dr. A. F. Hurst.

At 12 NOON.—Discussion: The Treatment of Gangrene. W. S. Handley, P. Turner, and E. G. Slesinger.

Friday, July 27.

At 10 A.M.—Discussion: Acute Nephritis. Prof. T. G. Moorhead, Dr. H. L Tidy, Dr. T. I. Bennett, Dr. H. Gainsborough, and Dr. R. L. McKenzie Wallace.

Discussion: Pancreatitis. J. W. G. Grant and Dr. A. F. Hurst.

Papers: Prof. W. W. Chipman: Acute Conditions in the Lower Abdomen of the Female.—E. Williams: The Acute Pelvis.—Dr. G. G. Ward: Radium Therapy in Carcinoma of the Cervix Uteri; an Analysis of the Results obtained at the Women's Hospital in New York.—Dr. E. F. Murray: Radium in the Treatment of Carcinoma Cervicis and Intractable Menorrhagia.—Dr. J. Young, Prognosis and Treatment of the Albuminuria of Pregnancy.

Discussion: The Early Treatment of the Psychoses and Psychoneuroses. Dr. A. Helen Boyle, Dr. E. Mapother, Dr. R. D. Gillespie, Dr. Mary R. Barkas, Dr. R. G. Gordon, Dr. J. R. Rees, and Dr. I. S. Wile.

Discussion: The Falling Birth Rate in its Various Aspects—(*a*) The Biological Aspect, Prof. F. A. E. Crew. (*b*) The Economic Aspect, Prof. W. J. Roberts. (*c*) The Medical Aspect, Sir Thomas Horder, Bt. and Lady Barrett.

Discussion: Urticaria. Dr. A. R. Hallam and Dr. H. W. Barber.

Papers: Dr. H. C. G. Semon: Souttar's Steam Cautery in Dermatology.—Dr. J. E. M. Wigley: Thallium Epilation in the Treatment of Ringworm.—Dr. W. J. O'Donovan: Salvarsan Ill-effects and Fatalities.

12 NOON.—Discussion: The Diagnosis of Ureteric Calculi. Prof. A. Fullerton, Dr. E. B. C. Mayrs, K. M. Walker, J. S Joly, and H. Wade.

SATURDAY, JULY 21, 1928.

CONTENTS.

The Origin and Progress of Mankind.

SCIENCE would be writing its own epitaph did it not as occasion arises review old and apparently established hypotheses with a readiness to relinquish them in favour of newcomers, but equally it is the duty of science to walk warily and with circumspection lest it leave the solid track. The origin and progress of mankind have been the subject of two recent speculations which invite and demand close scrutiny.

According as they have laid stress upon one or other special character common to man and the primates, various investigators have placed the origin of humanity at different points in the evolution of the primate stock, but the drift of opinion has been to associate him closely with the great anthropoid apes. This close association is now contested by Prof. Henry Fairfield Osborn, who has recently stated that "no existing form of anthropoid ape is even remotely related to the stock which gave rise to man" and that these animals "constitute a separate branch of the great division of primates, not only inferior to the Hominidæ but totally disconnected from the human family from its earliest infancy." As Dr. W. K. Gregory has put it,

> "Professor Osborn holds that the existing apes have ape brains and ape minds, adapted for life in the forest; that they walk on all fours; that the human foot shows no evidence of derivation from an arboreal type; that when men climb they do so in an awkward un-ape-like fashion; that the Neanderthal race had descended from thousands of generations of upright-walking men; and finally, that man was already a tool-making, intelligent being in the Pliocene epoch, certainly more than one million years ago."

Pithecanthropus of Java is no longer to be regarded as an 'ape-man' link, but as a true 'pro-man,' walking erect and capable of human speech and thought.

Prof. Osborn's throwing back of the origin of the human stem to a far distant past, before the anthropoid stock had diverged, has been stoutly combated by Dr. W. K. Gregory, who considers that the line of man's distinctive evolution struck off from the primitive chimpanzee–gorilla group, and that its origin can reasonably be looked for "somewhere within the known range of the anthropoid group in the Miocene and Pliocene, that is, somewhere between Western Europe and Eastern Asia." In his more recent writings Prof. Osborn has definitely accepted the remote arboreal

ancestry of man, and traces the common characters of man and modern apes to inheritance from a 'neutral' stock which existed in Oligocene and Eocene times; so that the differences between the protagonists are reduced to two matters of interpretation: the age of the origin of the human stock, and the distinctive characters of the common stem from which have branched men and the great anthropoids.

It is clear that every scrap of evidence must be brought to bear on the problem. In his Romanes lecture on "Palæontology and the Evolution of Man,"[1] delivered on May 4, Prof. D. M. S. Watson, without dealing in any way with the discussion which has been proceeding in the United States, analyses the significance of the fossil evidence of man's origin. Founding upon the palæontological evidence of evolution, he deduces certain generalisations, and two of these in particular he applies to the interpretation of man's origin, namely, that "the evolution of an organ follows the same course in closely related but independent stocks," and that evolutionary changes in structure "may be, and perhaps generally are, such as to produce greater mechanical fitness for the special mode of life of the animals considered."

In the result Prof. Watson finds that modern anthropoid apes have specialised in arboreal life, while *man* has also become modified in a direction of his own, as his lower limbs have assumed the whole functions of progression and his arms have been freed for handling food and tools. But each group bears in its broad chest and far-flung arms, as well as in other bodily structures, evidence of descent from "an ancestral great ape, differing from modern forms in his less intense brachiating specialisations."

Curiously enough, Prof. Watson's palæontological generalisations have some bearing upon the second speculation which scientific investigators have recently been invited to consider; this deals not with the origin but with the progress of mankind. In his Huxley Memorial Lecture, "Conversion in Science,"[2] delivered on the same day as the Romanes Lecture, Prof. G. Elliot Smith stands forth as the champion of the principle of diffusion of culture in ethnological science and the relentless opponent of any speculation which would seek to interpret resemblance in manners and beliefs as an outcome of similarity of circumstances. He regards the hesitancy of scientific men to adopt a new generalisation as a function of old age and traditional obsession, and looks with hope to young men ready to embark on new adventures which seem hazardous to their elders. But neither the hazard nor the novelty of an adventure is a measure of its merit, and to most the test of an hypothesis will be its fitness to explain all the facts, balanced with its probability relative to knowledge already regarded as secure.

That diffusion of culture is as likely to be widely significant in ethnological science as is dispersal of species in biology, can scarcely be gainsaid, and Prof. Elliot Smith does well to emphasise its importance. To argue his case for dispersal, the biologist must show that the characters upon which he founds are significant of heredity, and can have arisen in no other way. So the proof of diffusion of culture must lie in combinations of symbols or beliefs or in detailed agreements which point unhesitatingly to an ancestral source and can have no other origin.

Prof. Elliot Smith is unwilling to admit the possibility of any other origin. He regards as a "reckless travesty of logic and consistency" the idea that in similar circumstances similar customs and inventions may arise. But on this matter biology has something to say. Prof. Watson finds it to be a general principle of palæontological evolution that "the evolution of an organ follows the same course in closely related but independent stocks," and it is one of the striking discoveries of modern zoology that 'convergent evolution' is a more general phenomenon than had been suspected; that, indeed, similar circumstances do often call forth similar structural reactions, even in unrelated animals. Surely it would be irrational to ignore in mental processes or in social development a biological principle which applies so widely to structural development.

With the merits of Prof. Elliot Smith's immediate application of the principle of diffusion of culture, the thesis that "the civilisation of the whole world was inspired by Egypt," that "not only Crete and Syria, but Mesopotamia and India, Africa and Europe, and indirectly the rest of Asia, Oceania and America derived their cultural capital from the same source," we are not here concerned, but in ignoring a broad biological principle there is a danger that dogma may replace dogma. The final scientific criterion must be "Prove all things: hold fast that which is good."

J. R.

[1] "Palæontology and the Evolution of Man: the Romanes Lecture delivered in the Sheldonian Theatre, 4 May 1928." By Prof. D. M. S. Watson. Pp. 28. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 2*s*. net.

[2] "Conversion in Science: Huxley Memorial Lecture, 1928." By Prof. G. Elliot Smith. Pp. 38. (London: Macmillan and Co., Ltd., 1928.) 1*s*. net.

Homogeneous Reactions of Organic Compounds.

The Mechanism of Homogeneous Organic Reactions from the Physical-Chemical Standpoint. By Prof. F. O. Rice. (American Chemical Society Monograph Series.) Pp. 217. (New York: The Chemical Catalog Co., Inc.; London: Arthur F. Bird, 1928.) 5 dollars.

IN recent years much attention has been given to the study of heterogeneous catalysis, and great dvances have been made in our knowledge of the fluence of surfaces in promoting chemical change. rof. Rice's present work provides a welcome eminder of the importance of the complementary problem of homogeneous catalysis, since, as he oints out in his introduction, organic compounds often non-reactive when freed from catalysts, but undergo rapid change when the necessary atalyst is supplied. As illustrations of this non-activity he cites the case of ethylene and bromine, which "practically cease to react when dry and nclosed by 'non-polar' walls of paraffin wax," nd the analogous phenomena whereby "the con-ersion of nitrocamphor to the pseudo form and the automerism of keto-enol isomers" are arrested when these substances are "free from catalysts and nclosed in a vessel with non-polar walls." A few xceptional cases, such as the racemisation of nene and the thermal decomposition of acetone, which chemical changes appear to take place in he vapour phase at elevated temperatures in the bsence of a catalyst, are, however, described in the nal paragraph of the book. In general, therefore, is admitted that organic reactions, which normally ceed only under the influence of a catalyst, may lso take place in the absence of a catalyst when ollisions of exceptional violence occur.

The commonest catalysts for homogeneous ganic reactions are acids and bases. Prof. Rice fers to describe these transformations as taking "under the influence of hydrogen and hydroxyl ions"; but this paraphrase (which is a egacy from the period when the study of dilute queous solutions threatened to monopolise the nterest of physical chemists) introduces limitations which are now generally admitted to be both njustified and unnecessary. Indeed, many of the ost dramatic illustrations of catalysis, such as the atalysis of the mutarotation of nitrocamphor by he addition of 1 part of piperidine to 100 million arts of benzene, which Prof. Rice cites in his hapter on isomeric change, have been observed in nhydrous solvents and with nitrogenous bases, under conditions which do not encourage the view that the active catalyst is the hydroxyl ion. Again, it is theory rather than experiment which limits the catalytic activity of an acid to the hydrogen ions produced from it, when the molecules of a strong acid may be even better catalysts than its ions, for example, for those transformations in which the migration of a proton is the essential feature.

From this point of view, definite progress was made when Brönsted pointed out that the modern definition of an acid as a substance which is able to give a proton to a base, leads logically to the conclusion that the anion of a weak acid must be classed as a base, and the kation of a weak nitrogenous base must be classed as an acid, since one can accept and the other can give a proton. When, therefore, ammonia and acetic acid interact to form ammonium acetate, the functions of the two radicals are reversed, the basic molecule of ammonia becoming acidic in the ammonium ion, and the acidic molecule of acetic acid becoming basic in the acetate ion. Experimental justification for this view has been found in Dawson's recent studies of catalysis by acids in the presence of their salts, and in the work done in Copenhagen and in Cambridge on the catalysis of the isomeric changes which give rise to the mutarotation of glucose.

These studies are of value mainly because they have provided numerical data for the catalytic power of the various molecules and ions which can give or accept a proton. Prof. Rice, however, is not yet prepared to give up the idea that the 'hydrogen ion' is the unique catalyst for these transformations, and has therefore put forward a modification of Lapworth's earlier theory that a minute trace of anhydrous hydrogen ions is solely responsible for the catalysis. Rice's 'dry hydrogen ions,' however, are no longer the naked protons or stripped atoms of the earlier theory (which have a heat of hydration of 260,000 calories, according to the calculations of Fajans), but are defined as "having a heat of hydration of 20,000 calories per molecule." They are, therefore, purely thermodynamic conceptions, to which no precise chemical composition can be assigned, and in this form their utility is not likely to be great.

Prof. Rice is, however, such a believer in the potency of hydrogen and hydroxyl ions that in his opening paragraph he expresses the opinion that it "seems to be not altogether outside the bounds of possibility that all slow reactions, which are really homogeneous, will fall into this class." Thus, in a subsequent chapter he suggests that the reversible

chlorination which gives rise to isomeric change in *N*-chloroacetanilide depends on a "simultaneous collision of a hydrogen ion at the amino group and a chloride ion at the *para* position," and, when referring to the Beckmann inversion, he expresses the view that "the action may then be regarded as simple hydrogen-ion catalysis." There is, however, no real justification, either theoretical or experimental, for supposing that all homogeneous catalysis can be reduced to a single type, since the mutarotation of beryllium benzoylcamphor, which is catalysed by acetone and chloroform, clearly depends on the ability of these substances to form co-ordination compounds with the metal, and is in a totally different category from the mutarotation of benzoylcamphor, which is a typical prototropic change, for which acids and bases provide the necessary catalysis. The fact that, in general, it is necessary to provide *both an acid and a base*, in terms of Brönsted's definition, in order to bring about changes of the latter type, is a recent discovery, which may perhaps find a place in later editions of the present volume.

In addition to the problems of homogeneous catalysis, which are so conspicuous in the chapters on isomeric change and on hydrolysis, an account is given under appropriate headings of the reactions of aliphatic and aromatic hydrocarbons, and of the various 'condensations' and 'transformations' which play such an important part in organic chemistry. Thus, a valuable summary is given of the work of Holleman and the more recent work of Francis, Hill, and Johnston on benzene substitution; and, although very little physico-chemical work has yet been done on substitution and condensation in organic compounds, it is useful to have these processes reviewed in the light of raw material for future research.

The author has not attempted to discuss in detail the influence on organic chemistry of the discovery of the electronic structure of matter; but this omission has made it easier to concentrate attention on the fundamental problems which form the main subject of the book, and the author may be congratulated on the success which he has obtained in presenting these in an attractive and useful form to the readers of his monograph. The appearance of this work is particularly opportune, in view of the fact that Prof. Rice has promised to take part in a general discussion on homogeneous catalysis, which it is proposed to hold at Cambridge at the end of September, under the auspices of the Faraday Society.

T. M. LOWRY.

Cleaning Coal for the Market.

Modern Coal-Washing Practice. By R. C. R. Minikin. Pp. 310 + 36 plates. (London: Ernest Benn, Ltd., 1928.) 45*s*. net.

IF it can be said of any machine or process that there is money in it, there follows the certainty that it will attract the attention of the commercial man, and he is sure to bring to his aid the engineer. The two acting together form a very strong combination, whose efforts more often than not bestow some benefit on the ordinary public. Books such as that under review are commonly records of the achievements of such combinations, although they are written in technical language so difficult to understand by the average reader.

It has been known for a long time that it pays to clean coal for the market, and at practically every colliery in Great Britain some effort has been made in the past to clean all the larger sizes of coal; but never before has so much attention been given to the treatment of the smaller sizes, that is, all the coal produced at the mine less than two inch cubes, than is being done at the present time. The sizing, sorting, and cleaning of coal might be all grouped under one title and called 'coal dressing,' but this term would be far too wide to apply in the present instance, for the author deals only with the smaller sizes; and although he has called his book "Modern Coal-Washing Practice," he gives some idea of the newer processes which do not involve the use of water. In addition to the results of the author's own experience, there is information collected from many different sources, such as the transactions of the scientific societies, the technical press, portions of text-books, and advertising literature, and the whole of these sources of information is rarely available except to the privileged few who may have a well-equipped technical library at hand.

One of the sources of information mentioned above is of comparatively recent growth. It arises from the modern tendency by firms who manufacture machinery, to employ men on the staffs who have received a sound technical training. Many of the more progressive firms have their own research departments, wherein university trained men strive to improve old machines, or to devise new ones, for special branches of industry. Whenever a new machine, or an old model improved, appears on the market, it is accompanied by well-written descriptions, usually well illustrated, which explain in a lucid way the principles underlying its operation, and, after making due allowance for possible commercial bias, it is surprising how much

nformation is available to anyone interested, from he source called advertising literature.

The early chapters deal successively with general onsiderations, the building construction involved, he assembly of material to be treated in feed-oppers ; and the first mechanical elements of the plant necessary, in the shape of waggon-tipplers, ucket elevators, conveyors, and dust extractors. Whilst this is mainly descriptive, the author ncludes many practical hints on the selection of plant. Chapter x. dismisses the subject of the zing of coal with great brevity, a fact which is ather surprising in view of the importance it has connexion with coal-washing. It is, of course, ue that a far larger range of sizes below 2-inch ubes are made in the United States than in Great ritain, but the smaller sizes are bound to receive ore attention in Britain as time goes on. The llowing chapter deals with the crushing of coal, d reasons are given for this practice, but it might ve been made more clear that the primary reason crushing in Great Britain is to help separate al from adherent shale. In the United States, ashing is done to assist in the substitution of the chine for the man, and perhaps more important ll, to satisfy the demands of a market created cultivated by far-sighted engineers at the nes, in addition to the separation of coal and The theory of coal-washing is next dis- the theory of minerals separation in ite an old subject and is to be found in books on mineral dressing. This portion adds thing to the theory of the subject, nor did the thor intend it to do so ; he, rightly, includes it an introduction to the most important part of book.

main theme of the book is to be found under Modern Plants and al examples of de are well done, complete with much awings, and photographs ; but the hich they are placed leaves something desired. It is the sequence of the descriptions t will be found confusing. It may not seem to tter what is the order in which the descriptions placed, and yet the arrangement may have ite a disturbing effect on the mind of a person ing to obtain a comprehensive view of shing. For this reason it would appear not written for students of mining schools. portion covers about 100 pages, or about one- of the whole work, which in itself forms an ument that a classification of the systems ought have been attempted, based on the general principles underlying the most important operation in each system ; an arrangement such as that suggested would surely have increased the value of the book to the student and to the general reader.

The usefulness of the book might have been further increased by the inclusion of a far greater number of flow sheet diagrams, which are, after all, the most comprehensive and intensive means of conveying a clear idea of a complete method of treatment, in any form of mineral dressing. There is something to be said for the line diagrams, which, although small, are very helpful, probably much more so than if they had been made larger and luded in folder form. Following this is an unt of the use of concentrating tables, a comparatively recent addition to the list of coal-dressing appliances, though very well known in other forms of mineral dressing ; but it is surprising to find this section placed in the same chapter as froth flotation, a subject of such outsta difference in principle as to deserve isolat rather more extensive treatment.

There are chapters on the drainage of washed coal, with hints on the use of conveyors and elevators as de-watering devices, and descriptions of special machines designed for this purpose as well as notes on drainage bunkers. The defilement of the washing water by the constantly increasing percentage of fine coaly dirt, known as slurry troubles, is dealt with, and there is an elementary account of the testing of the washability of coal by the sink and float test. Results are given to show how the test is applied, but they suffer from faulty tabulation. This is a subject on which an account of the complete scientific control of a washery might have been based, for although this testing seems to be something adapted to the needs of teachers in the instruction of students, it is a highly desirable method not only useful in the designing of a plant to treat a peculiar kind of coal, but should also be used constantly throughout the working life of the washery to make sure that there is no alteration in the washability of the ma

The various stages of the treatment might well be checked by assay, for the whole assay office, together with the necessary apparatus and simple reagents, need not be a costly affair ; and there is little doubt that in capable hands such an office would pay for its capital cost, upkeep, and depreciation many times over. Later on, costs and o commercial matters are considered. It is on this matter of costs that so much may be done to assist the management of collieries, a point which has been sadly neglected since the year 1914, probably

on account of the great instability of the costs of labour and materials. But surely a time has now been reached at which some stability in these matters has been attained, and costs of operations may be discussed once more with pre-War freedom, to the advantage of the coal industry as a whole.

The final chapter of the book deals with pneumatic separation, added as an afterthought as it were, and lending assurance to the view formed, that the subject matter had been drawn together in a hurry to the detriment of the treatment.

To summarise: considering how much matter has been written on mineral dressing, it is obvious that a student of coal dressing would do well to revert to the field of metalliferous mineral dressing, and work forward steadily to the narrower field of coal dressing, when the book might be very useful. The outstanding useful features are the descriptions of machines and processes, and all other considerations are subordinate to this.

C. HABBERJAM.

The Zeeman Effect.

Magnetische Zerlegung der Spektrallinien. Von Prof. Dr. P. Zeeman und Dr. T. L. de Bruin. (Sonderdruck aus Handbuch der physikalischen Optik, herausgegeben von Prof. Dr. E. Gehrcke, Band 2, Hälfte 2, Teil 1.) Pp. 595-682 + 1 Tafel. (Leipzig: Johann Ambrosius Barth, 1927.) n.p.

THERE is perhaps no name that has been more frequently mentioned in physical writings in the last ten years than that of Prof. Zeeman, and we welcome the authoritative account of the magnetic splitting of spectral lines which he has written with the collaboration of Dr. de Bruin.

The Zeeman effect has so dominated the theory of spectra in recent years that its theoretical aspect is fully discussed in all modern books on atomic structure, with but meagre accounts of the experiments on which the theory is based. It is therefore very interesting to have the experimental processes described in some detail, for it is easy to forget how difficult they are. Thus theory takes for granted that a certain component is displaced to a distance of say 17/15 of that of the normal effect, and forgets that the line itself has a finite breadth, that the magnetic field is not always precisely known, and that the distinction between 17/15 and 16/14 will anyhow only amount to a very small fraction of an Ångström unit. So, too, theory has built a vast edifice on measures of intensity, and it is easy to forget that the analysing grating itself alters the relative intensities of differently polarised components, so that only the most thorough investigation of these disturbances brings out the right result.

The work under notice begins with a historical account of the discovery, recording the fact that Prof. Zeeman was partly incited to look for it by reading that Faraday had attempted to do so, though without success. No mention is made of the fact, perhaps quite legendary, that when the circular polarisation was first observed, the electron was determined to have a positive sign through a blunder, with which everyone will have the sincerest sympathy who has ever had to decide the sign of any gyroscopic effect. The history is followed by a description of the apparatus necessary to observe the effect, and recounts the improvements introduced by various experimenters in magnetic field, grating, source of light, etc.

The authors then proceed to develop the theory according to the dynamical principles on which it was worked out. But nothing could better illustrate the great rate at which the theory has advanced than the fact that though their account contains everything known up to about the end of 1926, a great deal of it is now unnecessary. The wave theory has tidied up all the quasi-dynamical analogies by which the formulæ were originally suggested. For example, the interrelationship of the Zeeman patterns in weak and strong fields was worked out by a semi-empirical rule, "the permanence of g-sums," but it is now possible to trace the connexion in detail, and the permanence of g-sums appears merely as an elementary property of the coefficients of an algebraic equation. In fact, between 1926 and 1928 the building has arrived at the stage when most of the scaffolding can be taken down.

Though this main part of the theory has attracted most attention in recent years, and is therefore most fully discussed, other aspects of the Zeeman effect are also reviewed. Thus there is a short account of the effect in the more complicated spectra of the 'second grade' and in bands, in which both theory and experiment are still very defective, and an account of the inverse effect in solids and liquids. There is also an account of the resonance phenomena of Wood and Ellett. Furthermore, the Zeeman effect has achieved the dignity of having an 'applied' branch as well as a 'pure,' and a section is devoted to the remarkable discoveries of Hale concerning the alternating rotation of sunspots. Altogether, there is no other place where so full and trustworthy an account can be found of the various aspects of the Zeeman effect.

Index Biologorum.

dex Biologorum : Investigatores, Laboratoria, Periodica. Edidit G. Chr. Hirsch. Editio Prima. Pp. iv + 545. (Berlin : Julius Springer, 1928.) 27 gold marks.

THE "Zoologisches Adressbuch" issued by Friedländer for the Zoological Society of ermany was an invaluable work, but even its cond edition, issued in 1911, has long been out-of-te. The present work, compiled by Dr. Hirsch Utrecht, would be welcome if it did no more than ke the place of that. It does more : it comprends all biologists, "omnes investigatores, qui æ naturam ab omni parte indagant." The lines investigation are now so many and so diverse that ere is danger of hedges growing up between them. any workers fortunately insist on breaking rough the hedges, and it is to help them to clasp nds with their fellow-workers on the other side at this directory has been produced. It is not a ide only to some 14,000 individuals and their bjects of study, but refers also under the heading aboratoria" to more than 6000 institutions where ological studies are carried on. At the end is a of periodicals, but since these number only 357, so manifestly incomplete that it is scarcely th while to notice such omissions as NATURE and *Annals and Magazine of Natural History.*

Hirsch tells us that the preparation of this rk has taken him a year and a half, and that 00 hours have been spent on it by himself and assistants ; 30,000 letters have been dispatched all parts of the globe. When one examines the rk itself one can only marvel that it did not take ger. If the work is not complete the fault probly lies less with the compiler than with those who to answer his inquiries. A remarkable connation of this supposition is furnished by the to individual members of the staff al History Museum. While all the entific workers of the Botanical and Geological partments (including Mr. "Rams Bottom") find a ce, there are numerous omissions from the zoolo- and the Entomological Department appears be represented only by its past and present epers. The same applies to the workers of the perial Bureau of Entomology. The names are completely given in the entries under aboratoria." We decline to blame Dr. Hirsch these omissions. Some people, it is well known, a feeling of either superiority or modesty, or obably out of mere laziness, will not send the [illegible] this. They should not allow their own self-importance to have any say in the matter. The book is to be of use to their colleagues if not to themselves, and their refusal to take the small amount of trouble concerned will in the end react to their own disadvantage.

Fortunately, omissions of the kind just mentioned seem to be rare. Such errors as we have noticed, apart from occasional misprints, are due to the changes that have occurred since the information was collected. They will doubtless be corrected in the new editions that are promised ; but we must all help by sending such corrections to Dr. Hirsch. Thus can we best show our gratitude to him and to his publisher.

Our Bookshelf.

A Guide to the Literature of Chemistry. By E. J. Crane and Prof. Austin M. Patterson. Pp. ix + 438. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1927.) 25*s.* net.

ANY means of simplifying the essential and ever-recurrent business of "finding it in the literature" is certain to receive a warm welcome from chemists, more particularly if the simplification is accompanied by assistance in ensuring the exhaustiveness of the process. Useful introductory monographs on such lines have, of course, been published—those, for example, by Dr. F. A. Mason, and by Marion E. Sparks—but it has been left to the present and a former editor of the American abstract journal *Chemical Abstracts* to discuss and analyse the sources of chemical information in a really detailed manner.

Those who have had experience in securing exact and complete information on any chemical subject, whether academic or industrial, will be the first to utter a word of gratitude to the authors for having produced so informative a volume ; by those it will be constantly referred to as an *aide-mémoire.* The reviewer would recommend that any chemist who for the first time proposes to conduct a careful literature search should commence with an equally careful study of this book. It is, somewhat naturally, American in its features. Since the authors' claim to speak with authority is based—very securely based—on their experience in presenting the cream of the world's chemical literature in a form acceptable to American chemists, it would be strange indeed if their own journal and their own resources were not made to supply paint for their picture. Nevertheless, they insist that the literature of chemistry is international, and they have clearly endeavoured to present a well-ordered view of the whole landscape.

There are eight chapters, in which are discussed the problem and its objectives, books, periodicals, patents, other sources of information, indexes, libraries, and procedure ; in addition, the eight appendices (which occupy nearly half of the book)

provide lists of articles on chemical literature, of abbreviations, American libraries, periodical-lists, organisations, periodicals, dealers and publishers, and books. A. A. E.

Von den Follatères zur Dent de Morcles: Vegetationsmonographie aus dem Wallis. Von Dr. Helmut Gams. (Pflanzengeographische Kommission der Schweizerischen Naturforschenden Gesellschaft: Beiträge zur geobotanischen Landesaufnahme, Heft 15.) Pp. xii + 760 + 26 Tafeln. (Bern: Verlag Hans Huber, 1927.) 39 gold marks; 48 francs.

DR. GAMS is a well-known ecologist, or perhaps one should say geobotanist, of the Zurich school, and the present volume has resulted from an intensive study of a small portion of the Rhone valley and a mountain massif overtopping it. The district dealt with in detail is only 76 square kilometres in area. The account is divided into three parts, of which the first deals fairly fully with the environmental factors. Since the country investigated has altitudes ranging from 465 m. to 2980 m., and has had a complicated geological history, these are very diverse. The second part gives a list of the woody plants with the limits of their altitudinal zonation, common names, and soil preferences, and lists of several special groups of species.

The third part, occupying nearly three-quarters of the book, deals with the vegetation. The free-living and adnate communities of Cryptogams are classified and described, the forks of a dichotomous key being interpolated among the longer descriptive paragraphs. A similar method, of keying and describing the plant communities in one sequence, is employed in the very detailed account of the rooted vegetation. The life-forms of Raunkiaer are used as a basis for the classification of the types of vegetation, though the Geophytia include therophytic and cultivated communities. The six main headings are: Hydrophytia, Helophytia, Geophytia, Hemikryptophytia, Chamäphytia, and Phanerophytia. Under each of these the floristic composition and biological conditions of many communities are described with the aid of tables, figures, and diagrams. These communities have narrow limits and correspond rather to the 'associations' of the Upsala school than to any of the vegetational groups used by those working on the successional lines initiated by Clements. The work is prefixed by a full list of the contents and is accompanied by a loose coloured vegetation map, but it has no index. W. B. T.

A British Garden Flora: a Classification and Description of the Genera of Plants, Trees, and Shrubs represented in the Gardens of Great Britain, with Keys for their Identification. By Lieut.-Colonel J. W. C. Kirk. Pp. xi + 584. (London: Edward Arnold and Co., 1927.) 42*s*. net.

THE object of this book is to provide a means of the generic identification of hardy and half-hardy plants grown in gardens. Although thus restricted, the volume occupies 584 pages, since no less than 1050 genera are included. After an introductory chapter dealing with floral morphology, the principles of classification, and other subjects, a key to the 138 families concerned is provided. Then follows the main portion of the book which treats of the separate families, the Dicotyledons being arranged according to Bentham and Hooker, except that the Monochlamydeæ are split up and inserted in groups amongst the Polypetaleæ. The families are furnished with a key to the genera. Each genus is briefly described and accompanied by notes on distribution, culture, and frequently on the species of interest. The analyses and keys are original, as are also the numerous and very useful illustrations. Indications are given of the derivation and correct pronunciation of names.

The volume is the outcome of the enthusiasm of a non-professional botanist and horticulturist. It is well got up, and although a few inaccuracies may be detected, it has evidently been prepared with care. The elaboration of a key to include a selection of families from all parts of the world is somewhat of a feat, though the author's grouping of families may in certain cases appear strange; for example, the placing of the Amentiferæ at the end of the Polypetalæ. Colonel Kirk's book, however, can be as warmly recommended to botanically minded horticulturists, and should also be useful to university students and others who desire information as to genera which are extra British, but are in cultivation and thus readily accessible. A. D. C.

L'aviation actuelle: étude aérodynamique et essais des avions; l'aviation actuelle et la sécurité. Par A. Toussaint. (Nouvelle Collection scientifique.) Pp. vi + 315. (Paris: Félix Alcan, 1928.) 15 francs.

THIS paper-bound volume constitutes a notable addition to the general scientific series in which it is included. The author is Director of the Aerotechnical Institute of St. Cyr and chairman of the French National Committee charged with the examination of all new inventions relating to aviation. The book is comparatively small, while the subject is, of course, of considerable magnitude; but the author presents a very broad and logical treatment of aviation at the present time.

The first chapter, occupying more than half of the total space, deals in fair detail with the aerodynamics of the several elements of the aeroplane. The two succeeding chapters, of relatively short extent, are respectively concerned with studies of the complete aeroplane and with laboratory tests and air trials. The last two chapters are probably of most general interest, in that they comprise essays on the state of military, naval, and civil aviation, tabulate air records, and discuss the special problems of security in flight as dependent on construction, propulsion, and personnel. The diagrams leave something to be desired, but the treatment is adequate and interesting, although several of the more general sections are limited to the French point of view.

Molecular Physics and the Electrical Theory of Matter. By Prof. J. A. Crowther. (Text-Books of Chemical Research and Engineering.) Fourth edition. Pp. viii + 202. (London: J. and A. Churchill, 1927.) 7*s.* 6*d.*

PROF. CROWTHER has performed a great service to elementary students in producing this new edition. It has been necessary to displace part of the account of earlier atomic theories to make room for sections on the important advances of the last few years, but the greater part of the classical groundwork has been left intact. The chapter on quanta is particularly valuable, and one cannot but admire the apt metaphors with which Prof. Crowther has enlivened his subject, even if at times his statements on controversial points are unduly dogmatic. One might have expected that more space would have been devoted to the artificial disintegration of atomic nuclei by α-particles, and that more illustrations of the cloud trails of ionising particles would have been inserted; we believe also that it remains to be proved that one of the disintegration products of the nitrogen atom is helium. Prof. Crowther's task, however, has been far from easy, and altogether the result of his labours is an adequate introduction to more advanced treatises of the type of Prof. Sommerfeld's "Atombau," and to current physical literature.

Algebraic Arithmetic. By Prof. Eric T. Bell. (American Mathematical Society Colloquium Publications, Vol. 7.) Pp. iv + 180. (New York: American Mathematical Society, 1927.) n.p.

THE practice of holding summer Colloquia, at which courses of lectures on specialised branches of science are given, is worthy of consideration by some learned societies in Great Britain. Seven such summer gatherings have been held by the American Mathematical Society, and the lectures given by Prof. E. T. Bell at a recent one form the basis of the volume before us. The subject matter is intermediate between the modern analytical theory of numbers and the classical arithmetic developed by Gauss and his school. It is mainly concerned with the somewhat abstract arithmetical theories in which a few American mathematicians have found a rich field for investigation during recent years. What is given in the book is but a narrow cross-section of an extensive tract of only partially explored territory. Prof. Bell outlines a few promising directions in which progress may be made towards extending the known results of algebraic arithmetic. Many readers would be illuminated by seeing a few concrete illustrations of the theories to which these investigations lead.

W. E. H. B.

Socrates among his Peers: Three Dialogues. By Owen Grazebrook. Pp. x + 172. (London: Kegan Paul and Co., Ltd., 1927.) 6*s.* net.

THIS book is of special interest to the general reader in its presentation of the background of Greek social life with reference to the intellectual contemporaries of Socrates and Plato. The author carries us back to those more leisurely times in Athens when men were able to discuss at length such problems as those of immortality, justice, and the City of God.

There are three dialogues, the first taking place after a supper-party at which Socrates is ultimately induced to give his views on death. In the hereafter, time and space lose their importance and reality, nor can they fetter the soul as they had once appeared to limit or control the body. The second conversation takes place on the evening of the verdict against Socrates, and a stranger from Eos suggests that the evidence produced by the prosecution was insufficient. The last dialogue takes place at the Academy, the supper-party consisting of four visitors, and Plato's intended departure for Sicily introduces the discussion which centres round the City of God. The treatment of the themes and the local colouring are well executed.

H. D. A.

Food and Health: an Introduction to the Study of Diet. By Mrs. A. Barbara Callow. (The World's Manuals.) Pp. 96 + 4 plates. (London: Oxford University Press, 1928.) 2*s.* 6*d.* net.

IN these days, when importunate writers in the newspaper world urge us to eat this and avoid that, and conjure up needless uncertainties, this little book, comprising 96 pages of compact trustworthy information and advice, is calculated to preserve a steady view and balance in matters of food and health, and what may be reasonably expected to follow should prudent counsel prevail. "May not a reasonable man think that a cup of tea is not food?" asked the judge. "Not a medical man, my lord," said the witness. "I said a reasonable man," the judge replied (*Times*, Law Reports, April 1, 1927). It is, of course, arguable that if the beverage contains milk and sugar, here is a food, yet scarcely nourishment in the true sense. Mrs. Callow supplies an informing well-written chapter on the discovery of vitamins; another on their restraining influence in that widely prevalent disease, rickets, is a feature. The task outlined in the introduction, "to show how a complex problem can be simplified by the application of scientific knowledge," is certainly sustained.

The Land of To-morrow: a Mule-back Trek through the Swamps and Forests of Eastern Bolivia. By Henry M. Grey. Pp. 224 + 6 plates. (London: H. F. and G. Witherby, 1927.) 12*s.* 6*d.* net.

MR. GREY does not give the date of his journey through Bolivia, but apparently it took place some two or three years before the War. He went out to inspect a rubber estate owned by an English company. The local manager and agents did not welcome Mr. Grey; in fact, he found their attitude so menacing that he thought himself fortunate to leave the country unharmed. He was travelling the whole of the time, and the book contains little more than descriptions of the difficulties and discomforts of a journey through the Bolivian forest.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Mirage: Natural and Artificial.

NATURAL mirage is due to the passage of rays of light through strata of air in which the refractive index is a function of the height of the ray above the ground. In these strata the air, though not homogenous, is isotropic, that is, its optical properties at every point are the same in all directions but vary from point to point. In natural mirage the non-homogeneous strata generally form horizontal layers, and in different conditions the air above or below the stratum may be the denser. The refractive index of a gas depend almost entirely on its density, and, hence, if the pressure is constant (which may be assumed for the thin mirage producing layers) light will travel faster as the height of the ray increases if the warm air is uppermost, and vice versa.

Mirage is seldom absent on sunny days, but the conditions which make it conspicuous, namely, a large flat area, and sufficiently rapid variation of density in the refracting strata, are comparatively rare. All the phenomena of mirage, however, can be reproduced in a space of very moderate dimensions by substituting layers of fluid of varying densities for the corresponding strata of air, and I give here a short account of some experiments I have recently made in this way, using a glass tank with parallel faces. This was half filled with water. Sugar syrup was then carefully introduced below the water until the tank was full, and allowed to stand for some days until diffusion had produced a layer of suitable thickness, with the refractive index of water at its upper limit increasing to that of syrup below.

FIG. 1.—Hollow prism, containing layers of syrup and water (side elevation). AB, image of a vertical slit, showing by its curvature the variation of refractive index.

To examine the progress of diffusion, a diagonal was drawn across one of the glass faces of the tank, and this was photographed at intervals through the fluid from the opposite end. At first the diagonal is distorted only quite close to the surface of separation of the syrup and water. After a few days the distortion, though still large, is diminishing, and the form changes very slowly. The refractive index at each level could be determined from these curves, but a more direct measure was made by photographing the image of a vertical slit through a prism containing syrup and water which had been allowed to diffuse to the same extent as the fluid in the tank.

A tracing from one of these photographs is given in Fig. 1, from which it will be seen that a very fair representation of the distribution of the refractive index can be expressed [1] by $\mu_y = \frac{\mu_1 + \mu_2}{2} \sin p_y$, where μ_y is the refractive index at level y, and $y = 0$ is the plane of the original surface of separation of the fluids, p being $= 2\pi/$*thickness of the layer of diffusion*.

[1] This is not the curve which would be obtained from the ordinary laws of diffusion, but is quite sufficiently correct for purposes of explanation.

A plane wave surface entering the tank parallel to the face at one end, assumes during its passage through the fluid a form such as is shown at BC (Fig. 2), and rays of light proceeding from a distant object in a horizontal plane become normals to this curved surface.

The fact that the wave surface closely approaches a half length of an harmonic curve and that the rays from the distant object are tangent to its evolute,

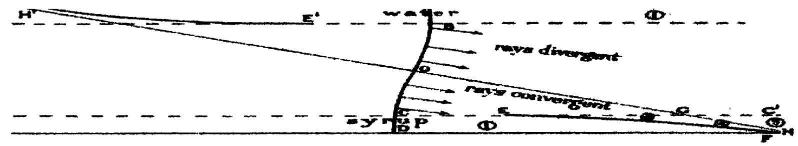


FIG. 2.—The course of rays of light passing through the fluid in the tank. AD, total depth of fluid. BC, thickness of layer in which the refractive index is variable, the curved line being the form taken by the originally plane wave surface entering the fluid at one of the faces. EF, E′F′, branches of the evolute of this curve; H′OH, asymptote of the evolute.

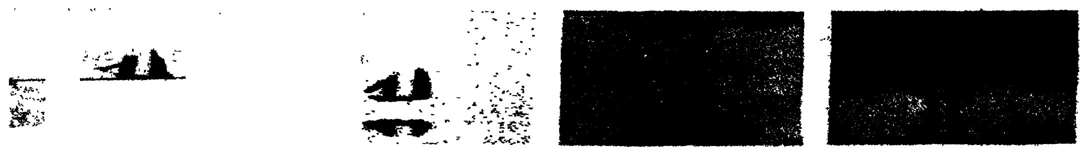
makes it easy to describe the appearance which will be presented to the eye in any position in their subsequent course. In Fig. 2, EF and E′F′ are branches of the evolute, and BC and HOH′ their asymptote. The horizontal lines through B and C are the boundaries of the layer of diffusion.

Whether one or more images of the distant object are visible depends on the number of paths by which a ray can reach the position of observation.

The positions may be grouped as follows:

Position bounded by the lines.		Visible.
(1) AA′ and BB′ CC′ and DD′	Single image	erect, un-distorted.
(2) B′BOGC′	,,	erect, vertical scale contracted.
(3) GOC	,,	erect, vertical scale expanded.
(4) HGEF	Two images;	one inverted, vertical scale expanded.
(5) C′GH	Three images;	one inverted.

The alteration in the vertical scale depends on the convergency or divergency of the rays, *e.g.* of the normal to the wave front. In Fig. 2 the conditions are analogous to 'cold' mirage where the coldest air is near the ground. In physical atlases, one used to see pictures of "mirage in polar latitude," in which three ships appear one above the other, the middle one



4 4 5

FIG. 3.—Photographs taken from positions corresponding to the points marked 1, 4, 5 in Fig. 2.

being inverted, and to reproduce this artificially a tracing-paper sketch of a ship was fixed to a window-pane and photographed through the tank. Fig. 3 gives examples of these pictures, the numbers under each referring to the position of the camera and indicated by the same numbers in Fig. 2. Some of the features of 'cold' mirage might probably be recognised in Great Britain on clear frosty mornings wherever there is a fairly large expanse of level ground.

The features of 'hot' mirage would be similar to those of cold taken in reverse order, but though 'hot'

mirage is very prevalent in desert and sandy places, I have never seen or heard of inverted images being recognised. The conditions where hot air underlies cold are much more unstable, and the occurrence of a sufficiently regular change of refractive index to produce two or three images must be rare.

The first noticeable effect of either 'hot' or 'cold' mirage is on the appearance of small objects near the horizon. 'Cold' mirage elevates the apparent horizon, while 'hot' mirage depresses it. In the former, if the base of the variable layer is above the eye of the observer, small bushes will look like trees or masts, and in the latter level ground will appear like a sea or lake.

As has been shown, a single layer of fluid of variable refractive index, increasing or decreasing regularly with the height, may give rise to three distinct images of the same object, and were it possible to have two separate layers arranged in the order, cold-warm-cold or warm-cold-warm, six images might be seen, though not all at the same time. Such a distribution would be very unstable, and probably has never been met with in Nature, but the conditions can be produced artificially by the use of thin hot plates.

I have made many experiments with hot plates and wires, some of the interference effects which can be produced by air heated in this way being very remarkable. The two described below have some bearing o the subject of mirage.

(1) *Hot Wire.*—In this experiment a beam of ligh parallel to the axis of a wire falls on a screen, eye-piec or photographic plate. A heating current can b passed through the wire from its thin support When the wire is cold, the field of view in the ey piece is uniformly lit by the source, except for th shadow of the supports which keep the wire in plac and show the usual interference bands visible outsi al contour of the shadows small objects. If, how ever, the wire is heate (by a current introduce through the support) large and intensely blac area spreads round th point previously occu pied by the shadow the wire, as shown in th photograph reproduce in Fig. 4.

FIG. 4.—Photograph showing dark space round shadow of hot wire. ... of the wire.

The dark area bordered by bright coloured interferen bands (twelve or mo can be distinguished b the eye), but these a difficult to photograp because it is necess to use a very small source of light, which necessita long exposure, and the air currents set up by eated wire cause the bands to shift irregularly.

When the wave front first meets the wire it i lane, but on leaving, the effect of the temperature een to produce a sort of pointed boss on the surfa ot unlike that seen on some 'native' shields. olourer bands are formed by the interference of artial waves emanating from the region round boss,' and there is no difficulty in calculating th pacing and intensity.

Though the phenomenon just described is rictly a mirage, its origin is analogous, both depe g on the curvature given to a wave surface assing through a medium in which the refract dex is a variable.

(2) *Hot Plate.*—Another experiment showing a t mirage may be made by substituting a thin flat plate for the wire and placing a collimeter in front of the point source of light. Between the collimeter and the plate place a straight thin wire at right angles to the axis of the beam, and parallel to the plane and the plate, and examine the image of the wire by a telescope instead of using only an eye-piece. When the plate is cold the image of the wire is straight and well defined, and the plate seen edgewise out of focus. On heating, the appearance is that shown in Fig. 5 (*a*), and if the wire is actually in the plane of the plate the mirage image forms a complete loop as in (*b*).

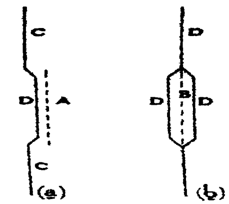


FIG. 5.—(*a*) Vertical wire C at a small distance from the hot plane of the plate A bent by mirage over nearly the whole depth of the plate. (*b*) Vertical D wire in the plane of the plate. Mirage causes the image to form a complete loop round the plate B.

In natural mirage it is not to be expected that the variation o the refractive index should be uni form as in the diffusion layers c liquids in a tank, and many of th odd effects which are occasionall reported as having been seen whe natural mirage is present are due t these irregularities. Such effect can be reproduced artificially by slightly disturbing the fluid in the tank or by introducing fresh fluid at any desire

A. MALLOCK.

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Racial Zones and Head Indices.

IN the issue of NATURE of April 7, p. 532, there is a lengthy review of my recent book, "Environment and Race," by Dr. Haddon. It is gratifying to find that so distinguished an anthropologist has many pleasant things to say about the book, but he raises one or two problems which I cannot have made clear in my discussion of racial zones.

In the first place, I would point out that the head indices given for Central African negroes were based on various authorities. Deniker gives 69·8 for the skulls of Wolofs. Many of the Guinea and Central African negroes are given as 74 or 75 as Dr. Haddon states, but practically all are lower than any quoted for the European zones to the north. The higher indices from the Cameroons and Congo basin can, I think, be fairly explained by the prevalence of a substratum of broad-headed negrito stock. I show them clearly on my map (p. 103) with many outlying negritoid tribes (marked by crosses) just where Dr. Haddon's high indices occur. To quote p. 106, "The pygmies vary considerably in cephalic index, but it seems in many cases to be 79 or 80. Their habitat extends across Central Africa." I specifically object in the book to any connexion between the broadheaded negrito in Central Africa and the Alpine races (p. 224), and I prefer to postulate a separate negrito stock which was thrust to the ends of the Old World by more progressive and later-evolved races. Thus it is not correct to say that on my theory negroes with an index of 80 "should be . . . early Alpines." It seems to me that the negro folk have head indices averaging around 73 or 74, the Hamitic folk around 75 and 76, and the Nordic around 78 and 79, etc., and the general principle of zoning is not invalidated because variations from the general average are common enough.

I feel that many of my critics disbelieve in the cephalic index as a test of race. I may mention that I consider (p. 41) the section and colour of the hair and

the nasal index as well as the cephalic index in my conclusions. My generalised map of race migrations was published in December 1919 by the *Geographical Review*. It is reproduced with only minor changes in my recent book (1927). I ask anthropologists to consider the present map of head indices (Fig. 1), which is essentially that given by Biasutti (plate vii) in his "Antropogeografia Generale" (Florence 1912). I first saw the map in 1922, and I have redrawn it on the polar projection to show the corridors of migration from Asia. My theory of migration zones is, I think, as clearly shown in Biasutti's map as in the frontispiece of my own book. There is the belt of narrow-headed races occupying Africa, India, Australia. They have been thrust away from the Bering Corridor into the Yenesei Valley and Japan. In America they are found only in the extreme east in the Hudson Bay region and in Brazil.

In Central Asia and along the main corridor to Europe are the broadest-headed races, which I call 'late Alpine.' The same types occur down the corridor in the west of the Americas. May I quote

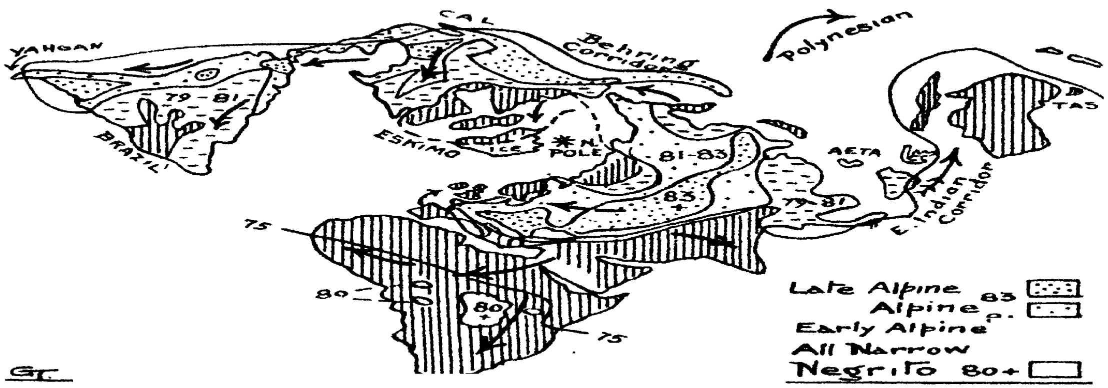


FIG. 1.—Distribution of head index (after Biasutti). The migration arrows and the isokeph for 75 in Africa added.

Dr. Marett's review in which he says of this 'migration-zone' theory that it is "a working hypothesis of singular breadth and completeness"? What alternative is there to my theory which will explain these zones? As I point out in my book, it is from the ethnological fossil record (*i.e.* in archæological strata, etc.) that we shall learn the evolution of the races of man. I advance evidence to show that the *order* of these zones is repeated in the ethnological strata, where they have been investigated. Hence the Alpine races appear to be evolved more lately than the Mediterranean or negroid races.

Finally, I may perhaps be permitted to mention that it was partly due to a discussion with Dr. Haddon on our journey to Broken Hill in 1923 that I relegated most of my brief and specifically 'tentative' account of culture to an appendix. One form of culture, language, I have discussed more fully; and I have tried to show how and why language zones and racial zones do not agree (p. 162).

It can be but rarely that a text-book has been written under such disabilities as affected that under discussion. When preparing the book in Australia (with the exception mentioned above) I had never come in contact with any expert who had an interest in anything anthropological save the Australian aboriginal. I am the more grateful for its kindly reception.

GRIFFITH TAYLOR.

University of Sydney,
May 15.

EXPERIENCE has shown that it is often dangerous to place too great reliance upon averages when dealing with distributions, and this is particularly the case with the head index. In a map of the world on a very small scale, it is impossible to avoid broad generalisations which mask important racial movements; as an example, one has only to compare Arabia and India in Prof. Griffith Taylor's diagram of Biasutti's pl. vii. with the original.

The broad facts of a zonal distribution of the head index are clearly brought out in Griffith Taylor's maps, but it appears to me that they are apt to produce a wrong impression on those who have not made a study of human races and their distribution. The pleasing simplicity of this presentation is a snare, as the problem is really a very complex one. Perhaps I should not have referred in my review to 'early Alpines,' since Griffith Taylor had left a loophole for brachycephaly in Central Africa as being due to a Negrillo element on p. 106, though on p. 225 he refers to this stock as "comparatively narrow-headed as in Africa." I would like to take this opportunity to say that I consider the polar projection maps of Griffith Taylor to be of very great value in showing the corridors of migration by land.

A. C. HADDON.

The Reflection of X-rays from Glass and Quartz.

IT is well known from the work of Compton and others that X-rays can be reflected at glancing angles up to about 40′, and Holweck claims to have observed reflection at 16°·2.

We have obtained evidence of reflection of X-rays of about 50 A. from glass and quartz up to glancing angles of 45°, the maximum observable in the spectrometer used. The X-rays from a target upon which electrons from a Wehnelt cathode are incident, are reflected from the glass or quartz plate in a vacuum spectrometer on to Schumann film. This reflecting plate is mounted in the place of the crystal of the spectrometer. Copper and carbon targets, with difference of potential between cathode and target of 10,000 and 375 volts respectively, have been used.

The photograph obtained with the reflected rays shows a laterally inverted slit image of the focal spot, and the angle of incidence is accurately equal to the angle of reflection.

The ratio of the intensity of the incident to the reflected beam with the carbon target is about 2 to 1 up to angles of 35°. Above 35° the intensity of the reflected ray diminishes.

The question arises whether the radiation reflected is X-rays, or ultra-violet light in the Millikan-Lyman region, or cathode rays. As the photographic film is enclosed and placed opposite the slit (0·05 mm. wide) in a metal box which is at the potential of the negative end of the filament of the cathode, the rays cannot be cathode rays.

The radiation (1) is absorbed by glass and fluorite; (2) penetrates aluminium foil 0·0006 mm. thick; (3) has an intensity (as measured by the action on the film) which is determined by the current in the tube at constant potential. (1) excludes the region from about 8000 A. to 1200 A. of the spectrum; (2) excludes the Millikan-Lyman region; and (3) is consistent with the hypothesis that the radiation is X-radiation which is emitted according to the usual laws. With 375 volts potential difference and a carbon target the radiation will consist mainly of the K line of carbon of 45 A.

The results obtained do not appear to be reconcilable with the Lorentz dispersion formula.

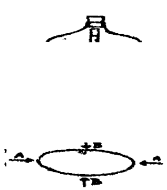
If these preliminary observations have been correctly interpreted, X-rays can be reflected from spherical surfaces and brought to a focus. This makes possible new methods for the study of long X-rays.

T. H. LABY.
J. SHEARER.
R. BINGHAM.

University, Melbourne,
June 26.

A Cartesian Diver Experiment.

MOST of us are familiar with the lecture-table experiment known as the Cartesian Diver. A variation of this is shown in Fig. 1a. In this apparatus the diver is replaced by a test-tube T floating upside down in the water, being buoyed up by just the right quantity of air, A. The tall jar is nearly filled with water, and then capped by a rubber membrane tied on tightly. When the membrane is pressed in, the pressure of the air just below it is communicated through the water to the air, A, within the test-tube (thus illustrating Pascal's principle). This lessens the volume of the air, and thus its buoyant force (thus illustrating Archimedes' principle), and consequently the test-tube sinks. The tube may therefore be caused to float or sink or remain stationary in the water by suitable pressure on the rubber membrane.



(b)

FIG. 1.

In the further modification which I am about to describe, the rubber membrane is replaced by an india-rubber stopper, but the change of pressure may be produced in another way. A bottle (Fig. 1 b), about 9 in. high, of oval cross-section (such as is sold with patent medicines), is filled with water. In it is placed, upside down, a little glass tube (a small phial or specimen tube), just buoyed up with the right amount of air so that it floats.

A rubber stopper is inserted in the neck of the bottle, either eliminating all the air or leaving in just a bubble. A slight adjustment of the stopper makes the little tube either sink or rise, as before. The interesting point now is that if when the tube is floating, the bottle is grasped in the hands and squeezed hard in the directions B B, the tube sinks. Also that if when the tube is at the bottom, the bottle is squeezed hard in the directions A A, the tube rises.

The phenomenon thus illustrates the change of volume brought about by deforming the cross-section of the bottle. Squeezing at A A makes the cross-section more circular, thus increasing the area; squeezing at B B makes the cross-section more elliptical, thus decreasing the area.

The bottle experiment was brought to my notice by one of my students, Mr. A. E. Allin, and it deserves a wider acquaintance.

JOHN SATTERLY.
University of Toronto.

The Spectrum of Ionised Sodium.

WITH reference to the interesting and important note by O. Laporte in NATURE of June 16, p. 941, the pairs of differences in the wave numbers which I found in the Na II spectrum do not appear to be accidental. For example, using Laporte's notation:

$$p_5 - p_4 = 218$$
$$p_6 - p_5 = 697$$
$$p_8 - p_4 = 2467$$
$$p_{10} - p_2 = 7285$$

and it is probable that the other pairs of differences will be found as differences between the values of the s', d, and d' terms, which, from the preliminary analysis of Laporte, appear to resemble in number those found by Paschen in the analysis of the Ne I spectrum. Mazumdar (*Indian Journal of Physics*, p. 345; 1928) has noted, previously, that the frequency differences between the four lower levels $^3P_2$ $^3P_1$ $^3P_0$ $^1P_1$ are respectively, 765, 592, and 2481 cm.$^{-1}$, and he has arranged the multiplets from the combinations $6L_2 \longleftarrow 5L_2M_1 \longleftarrow 5L_2M_2$ and $5L_2(M_2 \longleftarrow M_3)$, but in his classification S P D terms correspond to the p terms of Laporte.

It is to be expected that the Na II spectrum will yield on analysis series similar to those found by Paschen for Ne I, but more experimental work in the Schumann region is required before any such analysis can be completed.

F. H. NEWMAN.
University College of the
South-West of England,
Exeter, June 23.

Monomolecular Films.

WE have read with great interest the letter of Messrs. Sheppard and Keenan in NATURE of June 23 (p. 982). Some recent experiments we have made with monomolecular films of the elastic jelly of vulcanised triolein lend support to the second of their two suggestions to account for the very low values for the film thickness of cellulose esters spread on mercury. They suggest that the low value of the thickness represents the thickness of a polymeric chain or sheet.

We have examined vulcanised triolein, and a series of polymerised products of increasing molecular weight obtained from it (P. Stamberger, *Rec. Trav. Chim. Pays-Bas*, **46**, 837; 1927). Increasing degree of polymerisation is paralleled by change from a viscous liquid to an elastic solid. We have measured the thickness of films on water of products containing one, two, and at least seven molecules of vulcanised triolein. The latter product is a fairly elastic solid. The thickness of the films of all these products is practically the same, namely, about 14-16 A. at 16° C. The value for triolein is 13·0 A. From these measurements, and measurements on the vulcanised fatty acids obtained by saponification, we conclude that in the polymerised products the molecules are joined side by side in a definitely oriented manner in long chains, leaving the polar groups unaltered. Full details of this work are shortly to be published.

B. C. J. G. KNIGHT.
P. STAMBERGER.

Chemistry Department,
University College, London,
June 27.

The Geophysical Institute at Bergen.

By Prof. D'ARCY W. THOMPSON, C.B., F.R.S.

THE little northern town of Bergen, sea-port, fishing-haven, market town, has done more for science in the last two or three generations than many—not to say most—university towns. Its Museum, famous both on its zoological and its archæological sides, is the focus of a number of institutions, libraries, museums, and laboratories, which form among them a real academic community. Prof. Kolderup, the mineralogist, is the present director of the Museum, with such men as Prof. Brinkmann and Mr. James Grieg to help him on one side, and Prof. Haakon Shetelig (a well-known authority on Runic inscriptions) on the other.

I remember the Museum forty years ago, when Danielsson was director, and Fridtjof Nansen had charge of the zoological collections—Danielsson who, with his friend Koren (a medical practitioner), had added a host of beautiful deep-sea things to the European fauna, and Nansen, who had just discovered (almost simultaneously with Cunningham) the hermaphrodite nature of the Hagfish and had written his beautiful memoir on *Myzostoma*, a curious parasite of the Feather-stars. Some few years before, the Bergen fjords had been explored by that great naturalist Michael Sars, parish priest on a neighbouring island, and by his young son George Ossian Sars, afterwards not less famous than the father; of whom the elder was the pioneer of all that deep-sea exploration which captivated Wyville Thomson and Carpenter and their friends, and culminated at length in the *Challenger* Expedition, while the younger laid one of the foundation stones of our scientific study of the fisheries by his discovery of the multitudinous eggs of the cod floating transparent and invisible at the surface of the sea.

For the last thirty years or more the work of Norwegian geophysicists and hydrographers has been no less important than that of their brother naturalists; indeed in several cases, as in Nansen's own, one and the same man has been distinguished both as naturalist and as physicist. Oslo has played its part in this work, but it is Bergen that has done the lion's share; and last month, on June 7, there was opened in Bergen a new and splendid Geophysical Institute, built wholly at the cost of Bergen men, without a penny of subsidy from the State. The chairman of the inaugural meeting was Mr. Johan Lothe, the leading apothecary in the town, president of Bergen's Museum, a generous donor to the new Institute; the Prime Minister, Mr. J. L. Mowinckel, a Bergen shipowner, was also there, whose munificent contributions to the new building had been larger still. Many and many an opulent British town might learn the A B C of civic pride and patriotism from the town of Bergen.

The new Institute is a handsome building, set in a fine avenue of old trees and built on a bluff commanding an extensive view over the fjord and the islands and out to sea. It consists of three main storeys, with ample cellarage below, and a central tower containing three more flats in which the meteorologists have their quarters. Here they not only receive their weather reports from the usual network of wireless stations, but all the while they keep watch on the sky and draw their forecasts largely therefrom, after the manner of the Norwegian school of meteorologists. Dr. Jacob Bjerknes, who represents the third generation of his distinguished family, is in charge of the meteorological part of the Institute.

The ground floor contains chemical laboratories and the main part of the physical laboratories: these being under Prof. Helland-Hansen's charge. The work to be carried on here consists of geophysical investigations of various kinds, particularly studies of wind and water-currents from the dynamical point of view, that is to say, in relation to, or in verification of, the theoretical work of V. Bjerknes, Walfrid Ekman, Sverdrup, Hesselberg, and Helland-Hansen himself. The *Armauer Hansen*, a small but very seaworthy vessel, is at hand for the purpose of these investigations; and it is characteristic of the Institute that all its staff are travellers and explorers as well as laboratory men. The *Armauer Hansen* is a little yawl of 58 tons burden, with a 40 h.p. motor to work the winches and to drive the vessel in case of need; and with this little boat the Bergen oceanographers have surveyed the whole north-eastern Atlantic as far as Rockall, the Azores and Madeira, again and again.

The fittings of the physical laboratories have been planned with great care and experience. No less than five rooms and two cellars have been arranged for magnetic work, and are completely enclosed in a Faraday cage, the network of which is hidden in the plaster of the walls. No metallic circuits of any kind enter or leave this cage; the iron window-frames form part of it, but may be supplemented if need arise by extra gratings. Many small 'gadgets' strike one every here and there. The ceilings are all fitted with rows of screw-sockets, into which hooks or rods may be screwed for the suspension of cables, pipes, or apparatus of any kind. The smaller rooms have their walls covered with jute, on which charts may be pinned. The furniture, desks, tables, drawers, etc., is all standardised and interchangeable. I was struck by the beauty of the woodwork everywhere.

The chemical laboratories will be employed largely in the titration of water samples for chlorine and for oxygen; one or two rooms are arranged for work at constant temperatures, the thermo-regulators being controlled by bi-metallic rods. A lift brings up the water-samples from store-rooms in the basement. The experimental tank is placed in the cellarage; it is built of reinforced concrete, and is 15 m. long by 1·2 m. broad, and 1 m. deep. Three pairs of large glass windows are

let into its sides for the study of sub-surface waves, vortices, and the like; and an electric tramway for the propulsion of current meters, etc., runs along overhead. Another and more unusual possession of the Institute is a disused railway tunnel, which runs for some 140 m. at a depth of 15 m. below the building. It has a constant temperature of 10° C., a little above the mean temperature of Bergen; and in this long, calm and uniformly heated tube it is hoped that various important aerodynamical experiments may be carried on.

The laboratories on the next floor are for Dr. H. U. Sverdrup, the well-known physicist and explorer, and for Dr. Krogness. Dr. Sverdrup will have his hands full for some few years to come with the observations made on his recent expedition on the *Maud* to the Siberian coast and Arctic Ocean. He and his colleagues believe that the work of this expedition has been of the very first importance on the geophysical side, next after the classical results of Nansen on the *Fram*; and they think that, profiting by all recent experience and using every modern method and device, they have brought home in the *Maud* the finest oceanographical material ever collected by any expedition. The scientific results of the *Maud* expedition are to be brought out as a separate publication of the Geofysisk Institut; and meanwhile her splendid outfit of apparatus makes a considerable part of the new laboratories' equipment.

While Dr. Sverdrup concerns himself chiefly with theoretical meteorology, Dr. Krogness occupies himself with terrestrial magnetism and cosmical physics. He is about to work up the magnetic observations from all over Norway in his new laboratory, and to undertake for the first time a magnetic survey of the whole country. In this work he is associated with a special commission including Prof. Störmer of Oslo, Prof. Saeland, Rector of the University there, and Prof. Lars Vegard, all three well-known students of terrestrial magnetism, while Dr. Störmer is famous for his mathematical studies of the aurora, for his calculation of the orbits of the cathode rays coming from the sun and of the influence of the earth's magnetism on their paths. Dr. Hesselberg, director of the Meteorological Institute in Oslo, is also associated with these investigations.

Going back for a moment to what I have been saying about the theoretical aspect of Norwegian oceanographical work, a beautiful example of the relation between observed fact and dynamical calculation is not far to seek, apart from the well-known and indispensable theorems due to Bjerknes. Recent cruises of the *Armauer Hansen* have added much to our knowledge of the course of the great North Atlantic Current popularly known as the Gulf Stream; and in a recent number of the *Geofysiske Publikasjoner*, Helland-Hansen and Fridtjof Nansen together have not only described its course and branching, but also have brought these phenomena into line with a beautiful theorem of Prof. Walfrid Ekman's. This theorem, published in the *Arkiv für Matematik* about five years ago, is an extension of, or corollary to, the well-known theorems which show how rotation of the earth influences the direction of an ocean current—a matter which one was apt to think had been fully explained. Coming from the westward, the great current reaches mid-Atlantic far to the west of the Bay of Biscay and about half-way between Rockall and the Azores. Here it swerves somewhat abruptly to the southward and presently divides into two branches (see Fig. 1); one, turning sharply northward towards the Porcupine and Rockall Channel, passes thence onwards into the Norwegian Sea; while the other

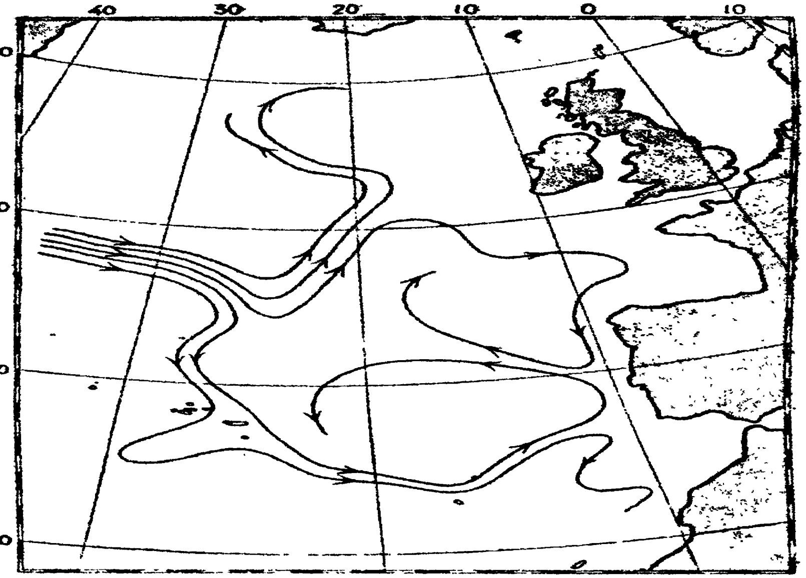


FIG. 1.—Skeleton-representation of the general sub-surface circulation of the eastern North Atlantic. From *Geofysiske Publikasjoner*, Vol. 4, No. 2.

and lesser branch continues to bend southwards towards the Azores, and then flows westward with more and more devious windings to Madeira and the Portuguese coast. Ekman's dynamical theorem tells us that a current flowing from a shallower to a deeper sea will (in the northern hemisphere) tend to be slewed to the left, and vice versa; this law holding good even though the depths be very great. Now there is a well-known 'Longitudinal Ridge' running north and south, midway through the crooked river-channel of the Atlantic; again, from the Azores to Madeira, the bottom stands somewhat higher than in the basins to the north and south, while between Madeira and Portugal soundings are variable and the topography complicated. Putting two and two together we see (or rather we are shown) how the great current bends southward (*i.e.* to the right) just when, and just because, it reaches

the comparatively shallow water over the Longitudinal Ridge. Next, that part of the current which is first to cross the ridge is sharply deflected to the left when (and because) it reaches the deep water on the eastern side, and so it shapes its course northward towards the Porcupine Bank and the seas beyond; while the other and lesser portion of the great current is slewed more and more to the right as it follows the shallow waters towards the Azores. Passing Madeira and approaching the Portuguese coast, the course of the current becomes extremely complicated; and "it stands to reason" (as our authors say) that it is here closely following, in all its constant twists and turns, the ups and downs of the complicated topography of the bottom.

Heterogeneity of Steel Ingots.

WHEN a mass of molten steel, originally of uniform composition, solidifies, the analysis of the resulting ingot shows variations from point to point due to local segregations of the various constituents. The extent of this variation differs widely in different cases, and certainly increases with poor steel-making technique. Even with the best of conditions, however, segregation inevitably occurs, and the Iron and Steel Institute appointed in 1924 an important committee to investigate this point and to discover, amongst other things, to what extent segregation must be considered to be inevitable even with the very best steel-making practice.

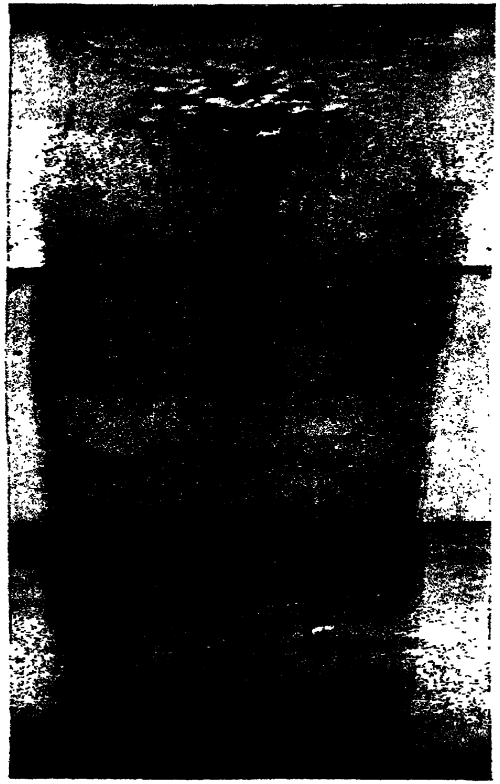


FIG. 1.—Sulphur print of an ingot of nickel-chromium steel showing Λ- and V-shaped segregations. From the Second Report to the Iron and Steel Institute of the Committee on the Heterogeneity of Steel Ingots.

The first report of this Committee was published in the *Journal of the Iron and Steel Institute*, vol. 113, in 1926, and dealt in an exceedingly able manner with segregation in plain carbon steels which were free from blow-holes. It was shown that the ingot could be divided up into zones purer than the average, and others in which definite segregation was to be detected. The lower part of the ingot, for example, is relatively very pure, and a region, shaped something like a sugar-loaf, extends upwards from the base along the central axis. Outside this are found a series of segregated zones of Λ shape separating the steel in the centre from another purer region under the skin. The most highly segregated field occurs at the top of the ingot just below the cavity in the feederhead, and from this the Λ segregates descend somewhat as do the fangs from a tooth. Finally, there is a series of V-shaped segregates extending down the axis of the ingot which may be connected with similarly shaped and situated flaws, due to contraction in the solid state. Fig. 1, which represents the sulphur print of an ingot of a nickel-chromium steel weighing 49 tons, shows these segregations clearly.

In a second report, recently published, the whole question is carried much further, and again comprises an account of some extremely careful work. It considers, first, segregation in sound alloy steels, and, secondly, segregation in ingots of carbon steel which had been deliberately produced highly charged with gas. This, on the solidification of the metal, had been liberated in part and produced blow-holes.

Dealing in the first place with the alloy steels of the nickel, nickel-chrome, and nickel-chrome-molybdenum types, ingots from 15 cwt. to nearly 120 tons have been examined and, generally speaking, the results obtained are closely similar to those given by the plain carbon steels. It is shown again that the degree of segregation normally increases as the size of the ingot increases. Nickel, although it does itself segregate, does so only to a minor degree, and in, for example, an ingot weighing roughly 3 tons, the nickel content in the highest analysis was 3·16 per cent, and in the lowest 3·05 per cent. There is also some reason to believe that the presence of this element has an influence in decreasing the extent of segregation of other elements, and taking, for example, a nickel and a plain carbon steel ingot of roughly similar size, the figures given below may be cited.

Element.	Nickel Steel Ingot. Highest (per cent).	Lowest (per cent).	Range (per cent).	Carbon Steel Ingot. Highest (per cent).	Lowest (per cent).	Range [1] (per cent).
Carbon .	0·32	0·28	13	0·43	0·32	32
Sulphur .	0·049	0·024	59	0·047	0·032	37
Phosphorus	0·032	0·022	29	0·055	0·039	37
Nickel .	3·16	3·05	3·5	nil	nil	..

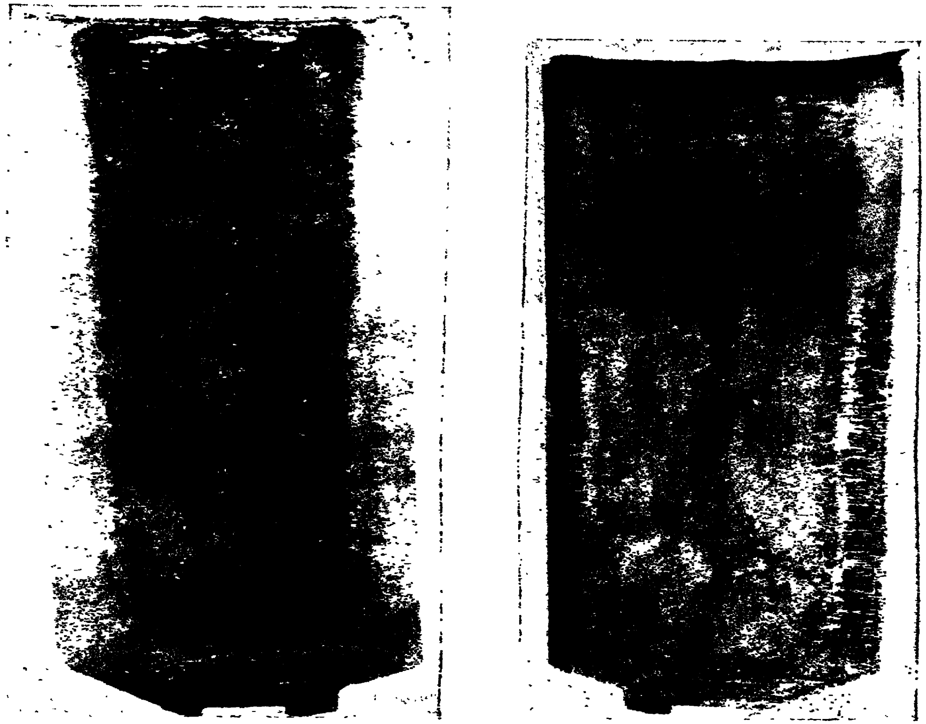
[1] Calculated on mean composition of ingot.

Although there is a slightly greater segregation of sulphur, in the nickel steel ingot the segregation of both carbon and phosphorus is reduced.

A point of very considerable interest is raised as a result of analyses which have been made on two similar ingots of a nickel-chrome steel weighing 2 tons 4 cwt. each. These ingots were prepared from the same electric furnace heat and differ only in the temperature at which they were cast and the speed of pouring. Ingot *B* was cast at an average temperature of 1590° C., and *D* was poured at 1550° C. The time of pouring of *B* was 3 min. 40 sec., while *D* was poured very much more rapidly in 2 min. 10 sec. The amount of segregation in ingot *B* was very distinctly less than that of the other ingot *D*. Expressing the maximum degree of segregation as the percentage difference of the maximum and minimum figures when compared with the average for the whole ingot, this range was for carbon 14 per cent in the case of ingot *B* and 24 per cent in the case of *D*. Manganese, which segregates only to a minor extent, showed no difference in the two ingots, the range being 7 per cent for each. In the case of silicon the range was 7 per cent for ingot *B* against 15 per cent for ingot *D*. The same phenomenon is shown for sulphur, phosphorus (where it is particularly marked), nickel, and chromium: the sulphur figures being 12 per cent and 25 per cent: phosphorus 7 per cent and 33 per cent: nickel 2 per cent and 3·5 per cent: and chromium 3 per cent and 4 per cent.

Another case of very considerable interest from the point of view of armament and special engineering material was a 119-ton ingot of nickel-chrome-molybdenum steel. Compared with a plain carbon ingot of similar dimensions, it is shown that the segregation of carbon, sulphur, and phosphorus has not been materially affected by the alloying elements in this size of ingot. Segregation of all three special elements is observed, nickel to a minor extent, the maximum variation being only about 5 per cent of the mean analysis; chromium to a considerable degree, about 30 per cent, and molybdenum to a very marked extent, giving a range of composition of 70 per cent. The regions in which these special elements segregate are roughly the same as those selected by the elements in the plain carbon steels.

The report then passes on to the consideration of heterogeneity in steel ingots which had not been 'killed,' that is to say, which were made from steel supersaturated with gas. The Committee points out that such ingots are representative of the great tonnage of steel produced for the manufacture of plates, sections, and other general purposes. Such ingots are chiefly characterised by the facts that the steels have low carbon and silicon contents and are cast in moulds which are not provided with feeder-heads. During the freezing of the liquid steel, there is a liberation of gas which results in the production of blow-holes in certain zones of the ingot, and it is the influence of this factor in modifying the degree and form of the heterogeneity to be found which has been considered. Owing to the volume of the blow-holes, the 'pipe' or central shrinkage cavity of the 'killed' ingot does not occur, and the fact that the small blow-holes in this class of material may weld up during the rolling process causes a much higher yield of marketable material to be produced. In the case



(a) (b)

FIG. 2.—Ingot of non-piping steel. (a) Sulphur print; (b) macro-etching. From the Second Report to the Iron and Steel Institute of the Committee on the Heterogeneity of Steel Ingots.

of steel required to withstand the most severe conditions of surface, the greatest precautions must be taken to reduce the gas content to a minimum, but it is neither necessary, nor economically practicable, to carry out the degasification to this degree in steel for the more common purposes. In fact, it is sometimes found to be actually desirable, in order to produce certain qualities in the finished product, to cast the steel while it is highly charged with gas.

As an example of one of the more extreme cases

may be quoted an ingot of steel intended for the production of weldless tubes by the Pilger process. This ingot, weighing just above 3 tons, was made by the basic Siemens process and was of the following average composition: Carbon, 0·064; manganese, 0·35; silicon, 0·012; sulphur, 0·039; phosphorus, 0·010 per cent. The sulphur print and the macro-etched structure are shown in Fig. 2 (*a*) and (*b*). It will be seen that four zones may be distinguished. There is, first, a thin solid outer skin about ½ an inch thick. Within this there is a zone about 4 inches thick free from segregation but containing numerous elongated blow-holes, especially in the bottom half of the ingot. Zone 3 consists of a thin envelope of highly segregated material containing numerous blow-holes of globular form. Finally, there is the central portion of the ingot, which appears to be more impure than zone 2, and the upper portion of which contains blow-holes both with and without segregates. There is no major pipe cavity, but there are shrinkage cavities in the centre of the ingot and traces of the V type of segregation. In the lower half of the central zone a particularly unsound area containing segregated regions of rather peculiar form is to be seen. An explanation of this unsoundness of the bottom of this ingot has not yet been found, but it is possible that the condition of the bottom plates on which the ingot mould had rested played some part in it.

Except in the case of silicon, the magnitude of the segregation phenomenon for the various elements in these steels containing blow-holes is of the same order as is found in the 'killed' piping steels. In the tube ingot a high value for the silicon content, however, was detected near the bottom of the ingot, but whether this would occur normally is still uncertain, since, as has already been mentioned, the condition of the bottom plates may have had some influence. Concerning the general distribution of the elements there is in these ingots, as in those made from piping steels, a concentration of the impurities (excepting silicon) in the upper parts of the ingot, though there is little indication of the negative segregation of carbon, sulphur, and phosphorus in the lower central region.

All the ingots show evidence of an increased silicon content in the lower middle portion to an even more marked degree than do the ingots of the 'piping' type dealt with in the first report. The ingots, further, contain V segregates near the central axis, though these are not so distinct as they are in the piping steels. The tube steel did not show the Λ segregate, though in the case of 'semi-killed' ingots this is again found, confined, however, in general, to a very narrow zone, except in the case of two ingots which had been cast at a low temperature. A distinctly interesting observation was made in connexion with an ingot weighing 3 tons 6 cwt. of a 'free-cutting' steel produced by the basic open-hearth process. The composition of this material was carbon 0·12, manganese 0·66, silicon 0·03, sulphur 0·113, and phosphorus 0·098 per cent respectively. Although the silicon content is very low and no additions of aluminium were made, the ingot showed the typical structure and features of ingots of 'killed' steel. The liberation of gases which is typical of low silicon, 'unkilled' steel has in this case been prevented by the high content of sulphur, an element which evidently acts as a powerful deoxidising agent.

The present report concludes with interim statements of work which is being done in the University of Sheffield on changes of the density of steel in the neighbourhood of the melting point and the viscosity of molten steel, and also researches being carried out at the Royal Technical College, Glasgow, on the freezing and melting ranges of the steels dealt with in the two reports and on the sulphides present in these steels. The amount of work which has been carried out for the purpose of these reports by the steel-making firms and metallurgical institutions of Great Britain is extremely great, and the value of the work when it is complete, both to the manufacturer of steel and to the user, cannot be over-estimated. As an example of a scientific investigation of a point of practical metallurgical importance, it would be difficult to call to mind any previous piece of work of this magnitude carried out with anything like the care and industry which has been shown in the present case. F. C. T.

Obituary.

PROF. E. M. CROOKSHANK.

THE sudden death of Prof. Crookshank on July 1 removes one who was a pioneer of bacteriology in Great Britain. He came of a family of soldiers, but at an early age showed a liking for scientific work, and after school days was first a pupil of Sir Ray Lankester at University College, whose teaching doubtless influenced his choice of career. Obtaining a science exhibition at King's College, London, he entered there as a medical student, and finally graduated as M.B. with honours in the University of London. During his training at King's College, Lister arrived in London to become surgeon to King's College Hospital, and Crookshank was one of his dressers and afterwards house surgeon at the Hospital. He thus early became imbued with the teaching of Lister and acquainted with the germ theory of disease. In consequence of his experience under Lister he was selected for special duty in the Egyptian Expedition of 1882, was present at the battle of Tel-el-Kebir, and received the medal and Khedive's star for his services. He wrote a report on the antiseptic methods employed in the campaign and gave valuable evidence before the Royal Commission on Medical Services in Egypt.

Following this, Crookshank decided to take up bacteriology as a career, and proceeded to study in Paris under Pasteur, and afterwards in Berlin under Robert Koch. Returning to London, he published in 1886 his "Manual of Bacteriology," which passed through four editions, was translated into French, and was the standard text-book of bacteriology at

the time in England. It was illustrated with many beautiful coloured plates, drawn, some by himself and others by Mrs. Crookshank. He was elected at about this time to a professorship of bacteriology in King's College, London, and founded there the first laboratory of bacteriology to be established in Great Britain.

Crookshank now devoted himself to research and educational work. He studied photomicrography, and in 1887 published a volume entitled "Photography of Bacteria." Many of his photomicrographs of this early period are excellent, and scarcely to be bettered now. In 1885 and 1886 he was studying the malaria parasite and trypanosomes. He was one of the first to recognise and confirm Laveran's work on the malaria parasite, and also confirmed the work of Evans on the trypanosome of surra, a disease of horses; and he published a paper in the *Journal of the Royal Microscopical Society* (1886) on the trypanosome of the rat, and his study of this parasite left little for later investigators to describe as regards its morphology and structure. Crookshank now in quick succession undertook researches on behalf of the Government, and furnished reports to the Agricultural Department of the Privy Council on scarlet fever and the Hendon cow disease (1887); anthrax, particularly in swine (1888); tuberculosis and actinomycosis in cattle (1888). His investigation of the Hendon outbreak of disease in cows, also of a similar outbreak in Wiltshire, proved that the condition was one of cow-pox.

This doubtless directed Crookshank's attention to smallpox and vaccination, with the result that he published in 1889 a considerable work in two large volumes on the "History and Pathology of Vaccination." He surveyed the earlier literature, and for this purpose the old book shops of Leipzig and elsewhere were searched for early and rare tracts and treatises, of which he acquired a unique collection. His views on the subject were decidedly heterodox, and at the time gained few adherents, though his criticism of some of the then popular conceptions would now be admitted as sound. He also studied the bacterial flora of calf-lymph, and while isolating numerous species from it, definitely asserted that not one of them is peculiar to vaccine lymph, and that the nature of the contagion is unknown.

With the exception of two papers on the chemistry of Koch's old tuberculin, this was Crookshank's last work of scientific importance, and in 1901 he resigned his professorship, being elected emeritus professor, and retired to his estate near East Grinstead. Here, while taking his share in local interests and becoming a Justice of the Peace, he maintained to the last a keen interest in scientific work and took a deep and active interest in the Royal Veterinary College, where he had lectured in early years, and of which he was a governor for nearly forty years, and had much to do with the recent developments in that institution.

Crookshank travelled much, was a keen fisherman, a good shot, and a skilled hunter of big game. Within the last year he had the good fortune to find and excavate some interesting Roman remains on his estate. R. T. HEWLETT.

As a result of a motor-cycle accident near Aberdeen on July 2, Mr. Alexander Reid has died at the early age of twenty-two years. A young man of great personal charm and scientific promise, he took his degree with honours in mathematics and natural philosophy two years ago at the University of Aberdeen. Since then he has been engaged in teaching and research. His work on the diffraction of cathode rays through thin films of celluloid, a preliminary account of which appeared in NATURE a year ago, has attracted wide interest. By a melancholy coincidence his definitive paper appeared in the *Proceedings of the Royal Society* within a day or two of his death. His remarkable success in the short time allowed him makes his early death peculiarly tragic, and his lovable nature had endeared him to all who knew him.

WE regret to announce the following deaths:—

Sir Frank Sly, K.C.S.I., formerly Governor of the Central Provinces, who took a prominent part in the development of agricultural research in India, on July 16, aged sixty-two years.

Sir George Wills, Bart., president of the Imperial Tobacco Company, a munificent benefactor of the University of Bristol and of the Bristol Museum and Art Gallery, on July 11, aged seventy-four years.

News and Views.

MANY scientific workers will remember the disappointment caused at the Oxford meeting of the British Association by the exclusion of a film of Chilian and Peruvian birds with which Mr. R. C. Murphy, of the American Museum of Natural History, had intended to illustrate a lecture. This year two similar incidents have occurred. Mr. Beebe, the eminent naturalist, was obliged to pay full duty on a film of a microscopical subject which he introduced for the purpose of exhibition to a learned society, and Mr. Wright, the distinguished American astronomer, who wished to use a film to illustrate a lecture before the Royal Astronomical Society, not only had to pay duty on his film, but was also put to a good deal of trouble by the Customs authorities. On hearing of Mr. Beebe's experience, the Association of Scientific Workers communicated with the Financial Secretary of the Treasury asking, either that special concessions should be granted as a matter of courtesy to accredited scientific workers wishing to introduce such films from abroad, or that the Finance Act be so amended as to allow for their importation without payment of duty. Independently, Captain Ian Fraser moved an amendment to the Finance Act of 1925 in the House of Commons on July 3 to the same effect. No decision has yet been reached, but, replying in the House of Commons to a question put by Sir Harry Brittain, the Financial Secretary to the Treasury

stated that his attention had been directed to the case of a distinguished American astronomer being subjected to considerable inconvenience and trouble in passing through the Customs two cinematograph films showing the successive phases of the planet Jupiter during its rotation, one for the purpose of illustrating a lecture, and the other for presentation to the Royal Astronomical Society. Some of the difficulties experienced were due to the importation of the films in passengers' baggage, necessitating their removal from Victoria to the Endell Street bonded film store. In view of this case, however, the possibility of shortening the procedure as regards films of a non-commercial character was being examined. Furthermore, the Chancellor of the Exchequer had promised that the practicability of an exemption for scientific films would be further considered.

SINCE the leading article in this week's issue on "The Origin and Progress of Mankind" was written, we have received Prof. H. F. Osborn's latest contribution to the discussion on the ancestry of man, an article entitled "The Influence of Bodily Locomotion in separating Man from the Monkeys and Apes," in the May number of the *Scientific Monthly*. By quotations from the writings of Darwin, he shows how closely that far-seeing naturalist's views coincide with the opinions, based on the vast amount of evidence since accumulated, of "the highest British authority (Sir Arthur Keith) and the highest American authority (Dr. W. K. Gregory)," that man's descent is to be traced to a primitive ape-like form more closely resembling the chimpanzee than man, but less specialised in ape-like habits than the orang. He proceeds to analyse the influence of bodily locomotion in changing the proportions of arms and legs relatively to the body, and in altering the characteristics of hands and feet, and is able to group this development in a series of "progressive arboreal stages." A close study of these stages leads him to the conclusion that while "the theory of arboreal ancestry of the human type is well established, both by the proportion of the limbs and possibly by the inturning of the soles of the feet, also to a less degree by the spread of the big toe," yet "the structure and proportions of the limbs, the hands and feet, taken together, do not harmonise with the brachiating ape theory, but to my mind suggest rather the taking off of the human stock from the second progressive arboreal stage, namely, arboreo-limb-walking stage." That is to say, Osborn regards the ancestral form of man as belonging to the type of creature which, while habitually terrestrial in habit, yet sought its food in trees and developed a tree-walking habit. "Derived from this stage, the pro-Dawn Man would conserve all the potentiality of future application of the hand to flint-making and, ultimately, to the arts and industries by which man has arisen."

EIGHT of the crew of sixteen of the wrecked airship *Italia* have been rescued, and two, Dr. Malmgren, the Swedish meteorologist, and Signor Pomella, an Italian engineer, are believed to be dead. Apart from General Nobile, who was rescued by a Swedish aeroplane on June 23, the survivors owe their safety to the Soviet ice-breaker *Krassin*, which found them on July 12. They include Majors Zappi and Mariano, who with Dr. Malmgren had left the wrecked party to walk westward towards the relief ships, and Lieut. Viglieri, who remained in charge after General Nobile's rescue. There is no news of the six men who were carried away in the wreck of the airship, and the likelihood of their being alive is small. It is reported that the *Krassin* will continue the search. She has already picked up her airmen, who damaged their machine after discovering the position of Majors Mariano and Zappi. At the time of writing there was no news of Capt. Amundsen, Lieut. Dietrichsen, and Com. Guilbaud, who left Tromsö in a seaplane on June 18. It is possible that they have found the missing Italians and are encamped with them awaiting a ship. Several aeroplanes are searching for them. Aeroplanes have picked up two men who were trying with dog sledges to reach Lieut. Viglieri's party, and the third member of this search party has reached the *Braganza* safely.

SOME details about General Nobile's first flight in May of this year are given by a *Daily News Bulletin* issued by Science Service of Washington, D.C. The aim on that occasion was to explore Nicholas or Northern Land, or at any rate to determine its western limit. The course of the *Italia* was north of Spitsbergen and Franz Josef Land, reaching about lat. 82° N. in long. 70° E. From there the course was south-eastward to lat. 79° 16′ N., long. 91° 40′ E. No new land was sighted and the western end of Nicholas Land was not seen, but the nature of the pack in the vicinity of the easternmost position reached is said to have led General Nobile to believe that land was not far distant. The return course to Spitsbergen was via the north of Novaya Zemlya and then across North-East Land. The course of the *Italia* on its way eastward crossed the reputed position of Gillis or Giles Island, reported so long ago as 1707. No sign of that land was seen. It has, however, long been supposed that Giles's discovery is identical with White Island in about 80° N., and that it was misplaced at a comparatively recent date.

THE direction of the prevailing wind in the North Atlantic is east or north-east above latitude 30° and south or south-west below latitude 30°, a fact known and applied by sailing-ships since the voyage of Columbus. Its importance for trans-Atlantic flights is even more vital, as appears from the series of successful easterly flights and the disastrous record of the westerly attempts by the northern route. The Italian pilots, Captain Arturo Ferrarin and Major del Prete, in their flight starting on July 3 from Rome to Brazil, in establishing a new record of geographical distance covered in a single stage, no doubt took intelligent advantage of the elementary principle involved. For strict comparison of these geographical flights, an accurate knowledge of the velocity of the wind, from point to point during the flight, is required, but making full allowance for favourable winds, a flight of 8000 kilometres from Rome to Brazil is a great feat of skill and endurance, and a severe test of engine and aeroplane design.

A PLEA for regional planning in the Lake district, vith the view of preserving its scenic features, is made 1 a pamphlet entitled "Safeguarding Lakeland," by Ir. E. J. L. James (*Whitehaven News*, Ltd., price 1s.). The danger that threatens the Lake district is the outcome of the use of the motor-car. There, as elsewhere, the motor-car leads to ribbons of urban growth spreading along the great roads, and to the construction of new roads for the same purpose. Ill-designed and badly placed houses are liable to spoil scenic features, while the straggling and unregulated growth increases the difficulty and cost of public services. Mr. James pleads for preparation without delay of a regional plan for the whole of the area, and embodies his suggestions in a map which shows that such a plan is under way only in the southern part of the Lake district, where several authorities have it in hand. He discusses at length the advantages of such a survey and the urgent need of some action if this unique part of England is to be preserved. It is a proposal which deserves to receive wide support. An appendix gives a list of the properties in the Lake district owned by the National Trust.

NOTICE has been recently directed to the valuable nmore estate, situated six miles from Dunoon, on Firth of Clyde, in Argyllshire, by a further gift to nation by Mr. Harry G. Younger. In 1925, Mr. unger presented the Benmore estate to the Forestry mmission on behalf of the nation, reserving the nsion house and certain other properties to himself. estate thus donated covers an area of 10,000 s and includes considerable areas of woods and ntations, containing a variety of conifers, thus ning a very valuable centre for the conduct of estry research work. It is also proposed to utilise a practical training centre for forestry students. e latter objects have become practicable by the ent gift by Mr. Younger of the mansion house the residue of the estate, with the exception of kford House, the River Eachaig, and certain villages. is now hoped that the Forestry Commissioners will able to provide accommodation for research workers d students on the estate itself. The forestry value Benmore is very considerable; but it has also tanical values of no mean order. Soil, climate, and elter are all excellent, as is well shown in the boretum and gardens, where the owners have perimented for more than half a century with a riety of exotic timber trees, especially conifers and rbaceous plants. The arboretum is said to be the rgest in Britain; it is believed that there is a prosal to make Benmore, in time, the national botanic of Scotland. A memorial to the late Sir aac Bayley Balfour, of the University of Edinburgh, King's Botanist in Scotland, has been under eparation in Puck's Glen. A rest house is being cted, which will be formally opened to the public occasion of the visit to Benmore of the British sociation at the Glasgow meeting in September next.

appeal is being made for contributions towards fund to supplement the money which the Trustees the British Museum have been able, out of the moneys supplied by Parliament, to provide for the exploration of the deposits in Tanganyika Territory and other parts of East Africa containing the fossil remains of dinosaurs. The Trustees have been able to maintain an expedition for four years, but now find themselves compelled to close it down on Dec. 31, unless the present appeal meets with substantial success. A beginning was made in 1924 with the collection of specimens at Tendaguru, under the leadership of Mr. W. E. Cutler. He was accompanied by Mr. L. S. B. Leakey, who had to return to England the following November in order to resume his studies at Cambridge. At his own request, Mr. Cutler continued the work alone, and unhappily contracted malaria from which he died on Aug. 30, 1925. The work was carried on by Mr. F. W. H. Migeod with the assistance of Major T. Deacon until the close of 1926, when they returned to England. Early in 1927, Dr. John Parkinson was appointed leader, and he left for Tendaguru accompanied by Major Deacon. During the rainy season in Tanganyika, Dr. Parkinson visited various sites in Kenya. He has, unfortunately, contracted amœbiosis and has to return to England for treatment. Major Deacon has been left in charge of the operations at Tendaguru. As the result of the expedition upwards of 500 cases of specimens have reached the Museum, but there has not been time to work out many of the specimens or even to unpack them all. The fund for which the appeal is now made is under the management of Lord Rothschild, Mr. C. Tate Regan, Dr. W. D. Lang, and Dr. G. F. Herbert Smith (honorary secretary), to whom contributions should be sent at the British Museum (Natural History), South Kensington, S.W.7.

THE following elections to Beit Memorial Fellowships for medical research have been made, the place of research being given in brackets:—*Senior Fellowships* (£700 per annum): Fourth year fellows elected to Senior Fellowships: Dr. A. S. Parkes (Department of Physiology and Biochemistry, University College, London), on the proportion of the sexes; Dr. Honor Bridget Fell (partly in laboratories on the Continent and in the United States), for experimental studies on the differentiation and dedifferentiation of animal tissues.—*Junior Fellowships* (£400 per annum): Dr. J. H. Quastel (The Biochemical Laboratory, University of Cambridge), for (1) extension of work on the chemistry of bacteria, with special reference (*a*) to pathogenic bacteria, (*b*) to the correlation of variations in antigenic properties of bacteria by changes in environment; (2) a revision and extension of work on the chemistry of complement fixation, attempting to define the nature of the complement of blood. Dr. P. W. Clutterbuck (The Lister Institute of Preventive Medicine), for the continuation of investigations of the nature and function of the succinoxydase system of muscle; investigation of the enzymic systems concerned in carbohydrate metabolism (*a*) by variation of the conditions, (*b*) by separation of the enzymes by means of adsorption and similar methods, (*c*) by isolation and examination of final and intermediate products. Mr. B. H. C. Matthews (Physiological Laboratory, Cambridge), to study (*a*) conduction in

sensory nerve fibres, with special reference to specific 'pain' fibres; (*b*) the characteristics of sensory end organs by observations on action potential recorded by means of an oscillograph system invented and made by himself. Mr. D. R. McCullagh (Sir William Dunn Institute of Biochemistry, University of Cambridge), for studies in carbohydrate metabolism, with the view of discovering the nature, distribution, and physiological significance of this factor and its effects on the alcoholic and lactic fermentations of glucose by the unicellular organisms, and to study the variations in the fat content of muscle under various conditions. Dr. W. R. Aykroyd (Lister Institute; also in Newfoundland, by personal investigations among settlements and inquiries among doctors), for an inquiry into deficiency diseases and their relation to diet, to investigate social and other factors which may account for the relative immunity of women and children to beri-beri in Newfoundland, to see if infantile beri-beri exists there, and to determine the relation to diet and vitamins of functional stomach disorders widespread among Newfoundlanders.

MRS. WALCOTT has given to the National Academy of Sciences, Washington, the sum of 5000 dollars to provide an honorarium and medal in memory of her husband, the late Dr. Charles Doolittle Walcott. The award is to be made every five years from 1932 onwards to a person of any nationality of either sex, between the ages of twenty-one and forty-eight years, who shall be deemed to have published important contributions to knowledge of Precambrian life. If there appears to be no worthy candidate at any period, the fund shall accumulate to be given at the next award. The selection of recipients will be made by five trustees, of whom two are to be members of the National Academy of Sciences, the third will be the Secretary of the Smithsonian Institution, and the others will represent the Institute of France and the Royal Society of London respectively. Geologists will welcome this valuable encouragement to the continuation of the important researches of the late Dr. Walcott, to whom we owe the greater part of our knowledge of Precambrian life.

A DISCOVERY of considerable interest, announced in the *New York Times* of July 5, has been made by the McCracken-Stoll expedition to the Aleutian Isles. At the top of almost unscalable cliffs, which it took five hours' hard climbing to reach, the party discovered a burial containing the bodies, with funerary furniture, of three adults and one child which, owing to climatic conditions, had been perfectly preserved. They were in a wooden vault fashioned of well-shaped and mortised drift logs fastened together by bone nails. The vault was lined with well-cured otter skins. All the bodies were wrapped, but one, evidently that of a person of importance, was more elaborately covered than the others, in tanned sea otter skins over a shirt of bird skins, with a cere-cloth of skins, and a further covering of artistically woven grass fabric. Over all was sea lion intestine sewn with animal sinew. The upright method of interment, the situation, and the possible high antiquity of the remains, make this a find of considerable interest to ethnologists. It may indeed be, as Dr. Clark Wissler is said to have suggested, a vestige of a migration of Mongoloids, hitherto untraced. For discussion of this and other questions of moment we must await a further and expert examination of the remains.

THE international and dominion delegates to the International Conference on Cancer, numbering 110 and representing eighteen foreign countries and six British Dominions, were received by the King at Buckingham Palace on Monday, July 16. In replying to the address presented by Sir John Bland-Sutton, past president of the Royal College of Surgeons and president of the Conference, His Majesty welcomed the delegates and said: "This large and distinguished assembly is a happy omen for the final success of the Campaign, for they will have opportunity of looking from every angle at this great and complex problem, of contributing to the general knowledge any light upon the subject gained by individual experience and of discussing and comparing the various practical methods for combating the disease. In struggling against so powerful and insidious an enemy, there is need for the most efficient staff work and the closest co-operation between all arms of our forces." Several members of the Grand Council of the British Empire Cancer Campaign, which convened the Conference, were also received by the King. The remainder of the week was devoted mainly to the discussion and examination of scientific and technical work on causes and cure of cancer.

THE annual report of the British Institute of Philosophical Studies has just been issued in connexion with the third annual general meeting held on July 18 under the presidency of the Earl of Balfour. The chairman of the Council, Prof. L. T. Hobhouse, in a foreword on the policy of the Institute, describes how special attention has been paid during the past year to the question of making the Institute a link between philosophic specialists and the general public. He maintains that a reasonable statement of the problems at issue and their implications is to be attempted, rather than a popular exposition of any one philosophical research. By way of illustration, he mentions the problem of induction, and he shows how it concerns everyone interested in science and everyone who accepts scientific authority. Reference is also made to the still deeper issue of perception and our relation to a reality external to ourselves. Prof. Hobhouse believes that, in its ideal, philosophy is synthetic, and that the constructions of physics, as of other sciences, should be integral to its fullest development. The members of the Council are very representative of those who are acknowledged authorities in various fields, and we welcome the work that the Institute is undertaking with regard to the relation of philosophy to modern thought and research. The membership roll now stands at about 1730, and during the past year 331 new members have been enrolled.

THE second session of the Institute of Chemistry of the American Chemical Society is being held at Evanston, Illinois, on July 23–Aug. 18. The pro-

ome includes a long list of interesting addresses nd discussions, and the names of the speakers are ich as to offer promise of valuable first-hand formation. Thus, to mention but a few examples, r. Gustav Egloff will discuss oil emulsions; Dr. L. Gabriel, vice-president of the Commercial olvents Corporation, will discuss the large-scale rmentation process for producing acetone and utyl alcohol; Dr. H. E. Howe will consider "Chemistry in the New Competition"; and Dr. J. G. ipman will discuss the influence of elements other han nitrogen, phosphorus, potassium, and calcium plant nutrition. Of special interest is a series f lectures by Mr. Lloyd Van Doren on the rôle of atents in the industrial system, and the drafting of pecifications and claims. Dr. C. E. K. Mees will ive an illustrated lecture on the photographic image. Prof. H. N. Holmes will deliver a course of lectures colloid chemistry, whilst Dr. H. A. Curtis will peak on the world nitrogen situation. Prof. B. S. Hopkins will direct a course of lectures on the methods teaching and the content of elementary chemistry ourses, and will in addition deliver a series of ddresses on the discovery of the elements. Sir James Irvine will also take an active part in the roceedings. Between seventy and eighty scientific workers, prominent in one or other of the many ranches of academic or industrial chemistry, are ontributing their services, so that the success of the etings should be unquestionably assured. The stitute held its first session last summer at the ate College, Pennsylvania.

THE Physical Society held a provincial meeting in stol on Saturday, July 7, at the invitation of of. A. M. Tyndall. This took place in the new enry Herbert Wills Physical Laboratory, and was ended by more than a hundred physicists from all rts of the country. The papers read at the meeting nsisted of accounts of research work which is now ing carried out at Bristol on the mobility of ions, gnetic properties of crystals, X-ray analysis of tty acids, distribution of photo electrons from a ckel crystal, developments of statistical mechanics. At the conclusion of the meeting the visitors d an opportunity, which was greatly appreciated, inspecting the laboratory and witnessing various monstrations which had been referred to in the pers. Prior to the meeting, the party was conducted to the Suspension Bridge, the Downs, Shirehampton, and the Avon Gorge; they also visited main University buildings in Queen's Road. The esident of the Society, Dr. W. H. Eccles, in thanking of. Tyndall, and through him the authorities of the niversity, for their courtesy and hospitality, referred the gifts of the Wills family to the University. He pressed the opinion that the new buildings constitute one of the most striking contributions of industry to learning in the history of Great Britain.

NATIONAL conference on maternity and infant lfare was held at the Guildhall, London, on July 4–6, der the auspices of the Central Council for Infant d Child Welfare. A long session was devoted to discussions on maternal mortality, one of the saddest causes of death, which has shown little diminution, and averages in Great Britain some 5 deaths of mothers per 1000 births. In some European countries, notably Holland and Sweden, it is much less, being less than 3 per 1000. There was a general consensus of opinion that a reduction of maternal mortality might be obtained by better training of nurse-midwives, and by more efficient antenatal supervision of expectant mothers, with provision of panels of obstetric specialists for the help of practitioners in complicated cases. Prof. Beckwith Whitehouse, of Birmingham, referred to the low maternal mortality rate of 1·3 per 1000 births attained by the Queen's nurses in nearly 56,000 cases during 1927, obtained, he believed, by good training of the midwives, antenatal supervision, and surgical cleanliness. Dr. Eardley Holland, of London, said that in Sweden, where the maternal mortality is 2·5, the medical curriculum lasts nine years and the students receive four months' residential training in midwifery, and the midwives two years' training in a maternity hospital.

THE result of the ballot for officers for the year 1928–29 of the Institution of Electrical Engineers is as follows: *President*, Lieut.-Col. K. Edgcumbe; *Vice-presidents*, Mr. P. V. Hunter, Dr. A. H. Railing; *Hon. Treasurer*, Lieut.-Col. F. A. Cortez Leigh.

RECENT appointments to the scientific and technical departments made by the Secretary of State for the Colonies include Mr. A. S. Walford, to be agriculturist, Jeanes School, Kenya Colony, and Mr. H. Earnshaw, to be schoolmaster, Agricultural School, Nigeria. Mr. M. T. Dawe, who has for some years been Commissioner of Lands and Forests, Sierra Leone, has been appointed Director of Agriculture, Cyprus.

DR. G. T. BENNETT, Emmanuel College, Cambridge, writing with reference to the letter entitled "Square Roots and the Decimal System" in NATURE of July 7, p. 15, states that the square-root and cube-root formulæ given by Mr. C. E. Wolff are only special cases of Newton's rule for approximating to any root of any equation.

ARISING out of Sir J. A. Ewing's James Forrest lecture entitled "A Century of Inventions," published in NATURE of June 16, p. 947, and the subsequent correspondence (July 14, p. 56), Mr. E. Wyndham Hulme writes stating that the first work which mentions the steam engine on its title-page is D'Acre's "The Elements of Water-Drawing . . . with a philosophical discourse, and a new discovery of drawing water out of great deeps by fier." London [1660]. Sm. 4to. There were two issues of this work, probably in the same year.

APPLICATIONS are invited by the Secretaries of the Royal Society for the Mackinnon and Moseley research studentships, each tenable for two years, with a possible extension, and each of the annual value of £300. The Mackinnon studentship is awarded for the purpose of furthering natural and physical science,

including geology and astronomy, and original research and investigation in pathology. The Moseley studentship is awarded for the furtherance of experimental research in pathology, physics, and chemistry, or other branches of science, but not in pure mathematics, astronomy, or any branch of science which aims merely at describing, cataloguing, or systematising. Forms of application, which must be returned by Oct. 8, are to be had from the Assistant Secretary of the Royal Society, Burlington House, W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A graduate assistant to teach in the Junior Technical School, and senior course evening classes of the Technical College, Barrow-in-Furness—The Director of Education, Town Hall, Barrow-in-Furness (July 23). A graduate assistant master, with special qualifications in electrical engineering, to take electrical and mechanical engineering subjects, and some mathematics, at the Dartford Technical College—The Principal, Technical College, Dartford, Kent (July 25). An assistant lecturer and demonstrator in mechanical engineering in the Faculty of Engineering of the University of Bristol—The Registrar, Merchant Venturers' Technical College, Bristol (July 26). A graduate assistant master for geography at the Smethwick Junior Technical School—The Director of Education, Education Offices, 215 High Street, Smethwick (Aug. 4). An assistant lecturer and demonstrator in botany at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Aug. 4). An assistant lecturer in the Department of Electrical Engineering of the University of Birmingham—The Secretary, University, Birmingham (Aug. 11). A lecturer in physics at Auckland University College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Sept. 15); The Registrar, Auckland University College, New Zealand (Nov. 1). The Alfred Jones professorship of tropical medicine in the University of Liverpool—The Registrar, University, Liverpool (Oct. 1). A lecturer in agricultural chemistry and an advisory entomologist, in the University of Reading—The Registrar, University, Reading. An entomologist for service in India—"India," c/o Richardson and Co., 26 King Street, St. James's, S.W.1. A principal of the Chadacre Agricultural Institute, near Bury St. Edmunds, Suffolk—The Earl of Iveagh, 11 St. James's Square, S.W.1. A senior mathematical master at the Cheadle Hulme School, Cheshire—The Headmaster, Cheadle Hulme School, Cheshire. An aeronautical examiner, Air Ministry, Kidbrooke—The Secretary (I.G.), Air Ministry, Kingsway, W.C.2.

Our Astronomical Column.

MERCURY A MORNING STAR.—Mercury will reach its greatest westerly elongation on July 21 (distance from the sun 20°). During the last ten days of July the planet may possibly be glimpsed near the west-north-west horizon at about 3^h 30^m A.M. The elongation is not a very favourable one, as it does not allow Mercury to remain above the horizon longer than about 1^h 35^m before the sun rises. The twilight is always very strong at this season of the year, but the planet may be glimpsed on very clear mornings of the period stated by anyone who has fairly good sight and looks in the correct direction. On July 29 the planet's brightness will be equal to -0.5 mag., which is about the same as Procyon, though not so great as that of Vega, Arcturus, or Capella. The disc of Mercury is so small that its light usually fluctuates or 'twinkles' like a fixed star, and this effect is enhanced by the unsteady vapours floating about at the low altitude in which the planet is always observed.

MAGNETIC STORM AND AURORA.—A magnetic storm, accompanied by a display of the aurora borealis, took place during the night of July 7 and morning of July 8. The magnetic disturbance reached a maximum between 1^h and 2^h on July 8, at the time when the aurora was seen at Greenwich to be at its greatest intensity. The range in declination registered at the Greenwich magnetic station at Abinger exceeded 80′, and this range occurred between 1^h and 2^h on July 8. About this time also, the horizontal force and vertical force traces went off the recording sheets. The ranges of those two elements exceeded 500 γ during the storm. This magnetic storm is probably the largest recorded at Greenwich since that of May 13-17, 1921—it is certainly the largest since that of Oct. 15-16, 1926.

At the time of this recent storm there was a moderate-sized group of sunspots just past the sun's central meridian. Possibly spectroscopic observations which may have been made of this group will show it to have been unusual. There was a much larger group on the disc at the time, but this was a considerable distance east of the central meridian. The sun's general activity shown by spots has been increasing during the last few weeks.

A GENERAL CATALOGUE OF STELLAR PARALLAXES.—Prof. F. Schlesinger, who is recognised as one of the leading authorities on the determination of parallaxes by photography, has brought out a useful general catalogue of the parallaxes of 1870 objects, being all for which good determinations were to hand at the end of 1924. The probable errors of the results of various observatories have been rediscussed, and are in general somewhat larger than those given by the observatories themselves. Weighted means were formed, these being the quantities given in the catalogue, but individual values for many stars are given in the notes. There are 23 stars with parallax greater than 0·2″, and 61 with parallax between 0·1″ and 0·2″. The former is probably not far short of the actual number, but the latter must be very incomplete, since we should expect it to be seven times the former. The adopted value for Betelgeuse is 0·017″ ± 0·004″; that for Arcturus is 0·080″ ± 0·005″; that for Nova Persei (1901) 0·011″ ± 0·003″, the trigonometrical value being practically the same as that deduced from the light-time of the illumination of the surrounding nebula. The reduction from relative to absolute parallax has been applied to the printed values, except in a few cases, mentioned in the notes. The reduction was made by the formulæ in Groningen Publications. The parallaxes of Cepheids and clusters are included in the catalogue; they are easily picked out, since they extend beyond the third decimal, and are preceded by a string of zeros. Proper motions are given (total amount and position angle), except for the Cepheids and other remote objects.

Research Items.

Man's Skull in the Light of Evolution.—The ıuman skull is a product of evolutionary change, and his could not be more clearly shown than by tracing a few clear-cut stages the history of the elements of which it is composed. Ten such stages are discussed by Dr. W. K. Gregory (*Internat. Jour. Orthodontia, Oral Surgery, and Radiography*, vol. 14, 1928). He shows how the gradual development of these stages is associated with improvements in the brain, enlargements of parts containing the sense organs, and modifications of the jaws and teeth, all accompanying or accompanied by changes in habits. Each and every one of the twenty-eight bones in the human skull is derived from bones present in the skull of certain Devonian air-breathing fishes. To the amphibians man owes the beginnings of his ear-drum, and the changes associated with it; to the first mammal-like reptiles his temporal fossa, zygomatic ·ch, and the dominance of the superior maxilla; to the higher mammal-like reptiles, the dominance of the dentary bone of the lower jaw, as well as the differentiation of his teeth into incisors, canines, premolars, and molars. The early mammals simplified the masticatory apparatus; the early primates increased the dominance of the eyes; the early ıthropoids made the first serious success in shortening and deepening the face and pointed the way to an enlarged brain and cranium—on their account men walk the earth to-day with long faces and swelled ·ds. It is an interesting story made clearer by Dr. Gregory's series of text-figures.

Noose-traps on the Congo.—Some remarkable ·ps for catching fruit-eating bats from the northern bank of the lower courses of the Congo around Brazzaville and neighbouring districts are described illustrated by Dr. Gerhard Lindblom in *Man* for me. These bats, known to the natives by the name *n'gembo*, come out in swarms after sundown, bitually flying through forest glades and the pressions in mountain ridges, places which the tives accordingly choose as the sites of their traps. The trap consists of a framework of which the prinal element is a long pole guyed with a rope, crossces serving as rungs of a ladder for arranging the ares. Rows of supple lianas are attached to the me-work with an arrangement of loops attached a slanting pole. These loops serve as pulley blocks rough which strings run down to a bottom crossce. By these strings the lianas are raised or vered, and the arrangement is such that the lianas be tightened up independently without entanglement. A specially interesting feature is that at the nction of the string and liana a bell is fixed which ıgs an alarm when a bat is caught. This bell nsists of the shells of a large land snail (*kodia*) or the nuts of the fan palm. The clapper is made bone or hard wood. The bells of the different nas are of different pitch, so that it is possible to stinguish in the dark by which of the lianas the ·ch has been effected. The snare is watched from hut nearby, and the watcher hauls down the catch soon as the bell sounds in order that the game ay not be frightened away. The bats are eaten roasted or boiled. Rites of magic import are formed both to secure an abundant catch and to re away evil influence. At the beginning of each nting season it is customary to crush between the eth the skull of the animal first caught and then eat the flesh—evidently a 'first-fruit' offering.

Birds of Brazil.—Birds from Brazil find their perhaps more frequently than birds of any distant land to the museums of Great Britain, an indication of their attractiveness, but also of a considerable amount of collecting activity in the country. Nevertheless, it is true to say that the knowledge which modern ornithology demands of the avifauna is very scanty. In spite of the opportunities afforded by great variety of altitude, through which climatic conditions change from tropical to sub-tropical and temperate, scarcely any attempt has been made to define in detail the life-zones inhabited by the birds. Ernest G. Holt has made a substantial effort to right this omission with reference to the locality of the Serra Do Itatiaya (*Bull. Amer. Mus. Nat. Hist.*, vol. 57, pp. 251-326). In a period covering four months he collected 559 birds, comprising with previous records a total of 187 species for the district. These ranged almost from sea-level to a height of 7800 feet, and an analysis of their altitudinal distribution showed that the tropical zone, embracing the foothills, was inhabited by 187 species; the sub-tropical zone, the region of tall trees extending roughly from 3000 to 6000 feet, by 62 species; and the temperate zone, the ridges, slopes, and rocky peaks above 6000 feet, by 12 species. The apparently small number of tropical zone species compared with those of the temperate zone, was due to the fact that the great bulk of the Serra lies above the tropical area. The distribution of each species is discussed.

Irish Cephalopods.—The *Proceedings of the Royal Irish Academy* (vol. 38, sect. B, No. 2, 1928) contains a description by Anne L. Massy of "The Cephalopods of the Irish Coast." This is a supplement to Nichols' list of cephalopods which was included in his "List of the Marine Mollusca of Ireland" (*Proc. R.I.A.* (3), vol. 5, 1900). This list contained seventeen species of cephalopods. In the present supplement there are thirty-two species, most of which have already been recorded, but without the detailed notes now supplied. The commonest Irish cephalopods are *Alloteuthis subulata* (Lam.) = *Loligo media* L., and *Loligo Forbesi* Stn. The *Helga* in forty hauls trawled 1070 specimens of the latter species, and in ten hauls 500 *Alloteuthis* were taken. The author follows Joubin in considering the short-tailed form, formerly identified as *Loligo marmoræ*, as the female of *Alloteuthis subulata*. The true *Loligo marmoræ* of Verrill, now called *Alloteuthis media*, is apparently not to be found in northern European waters. Among other rarities, a Rhynchoteuthis larva is described, the name apparently only applying to a larval form which belongs to the Ommatostrephidæ, but to what genus it belongs is not known. This larva, taken at 290 fathoms off County Kerry, measures 3 mm. in length, has only the dorsal arms developed, each with one sucker, and is possibly identical with one taken by the *Terra Nova* in the North Atlantic, described by Massy in 1916.

Phosphate and Silicate Content of Sea Water.—In a paper of general scope, Dr. W. R. G. Atkins brings up to date and adds much interesting detail to his previous well-known and valuable work (*Jour. Mar. Biol. Assoc.*, 15, 1; 1928). Spring sunshine appears to be the important factor in bringing about the spring diatom outburst. While the bottom is the most important source of phosphate, it is regenerated to some extent throughout the water column, and perhaps more rapidly at the surface than at intermediate depths. Phosphate may be completely exhausted in the surface waters in spring. Silicate tends to follow the same seasonal variation as phosphate, but differences occur, which are no

doubt correlated with the varying nature of the phyto-plankton and its varying demands. Dr. Atkins devotes much attention in this paper to technique and possible sources of error, and even for this reason alone the paper is important.

Trichuris AND *Ascaris* EGG-COUNTS.—C. Manalang (*Philippine Jour. Sci.*, vol. 35, No. 1, 1928) records observations on the relations between the number of ova per gram of formed stool and the number of female *Trichuris* and *Ascaris* harboured by their hosts (man). *Trichuris* egg-counts were made in four clinical and eighteen post-mortem cases, and the average number of eggs per gram of random stool, reduced to 'formed basis' (using Stoll's factor of 1, 2, and 4 for formed, mushy, and diarrhœal stools respectively) per female worm from the cæcum, transverse and sigmoid colon in cases with and without intestinal pathology, was 669 and 310 respectively. The number of eggs per gram of stool in the cæcum per female worm was about equal to that in the transverse and sigmoidal stools combined. The average number of *Ascaris* eggs per gram of stool (as above) per female was found to be about 1420 for the five normal cases, and in six cases with intestinal pathology about 1460.

Rhabdopleura IN NORTHERN REGIONS.—Dr. C. Jan Van Hast gives an account of *Rhabdopleura* in a recent part of "Die Tierwelt der Nord- und Ostsee" (Lieferung XI, Teil VII, *a*2, Pterobranchia). *Rhabdopleura Normanni* is the only member of the Pterobranchia found so far in the area described, but it has a wide range, occurring in many parts of the Atlantic as well as in South Polar regions. It is, however, most common in the north near Bergen, and in the Shetlands, preferably at fairly great depths (100 to 400 metres) although it has been found in shallow water of only 5 metres. It is usually taken on a stony bottom attached to mollusks, ascidians, and other animals, and is probably much more widely distributed than is at present known, as it is so easily passed over.

CHEMICAL COMPOSITION OF THE WHITING.—H. O. Bull (*Jour. Mar. Biol. Assoc.*, 15, 1; 1928) has studied this subject with special reference to the changes in the liver at different stages of maturity. The amount of fat is low in the immature fish, but increases with age, and reaches its maximum soon after the gonads begin to ripen. It then decreases, to reach a minimum when the fish are spent. No significant changes occur in the muscle substance. Work of this kind is of undoubted value in connexion with the study of condition in fish, and might be usefully supplemented by a study of the vitamin potency of the liver oil at different stages of growth and maturity.

SCANDINAVIAN PHYTOGEOGRAPHY.—After some delay, the results of the International Phytogeographical Excursion to Norway and Sweden in 1925 have been published (*Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich*, 4 Heft). The interesting discussions during the excursion have caused many problems to be viewed at a new angle, and many correlations in plant ecology, formerly obscure, have been made clear. As we might expect, the various papers contributed deal with aspects and types of Scandinavian vegetation, though in places they are compared with foreign but similar associations. Papers of general interest in the volume are: Some Scandinavian vegetation problems, by Edward Rübel; comparison of the *Betula* associations in North Germany and Sweden by Friedrich Markgraf; contributions to our knowledge of the vegetation of the Swedish lakes by Helmut Gams; the succession of plant associations in the Russian peat moors, and materials for the comparison of Scandinavian and Russian peat moors, by Wladimir Dokturowski; comparative considerations on the plant covering of the Scandinavian and Eastern Alps, by Friedrich Vierhapper.

PHYSICAL MAPS OF GREAT BRITAIN.—The Ordnance Survey has published two physical maps (price 1*s*. 6*d*. each), one of England and Wales, the other of Scotland, on a scale of one to a million. Each sheet is about 24 in. × 33 in. The network is a minimum error conical projection with rectified meridians and two standard parallels. The maps are layer tinted without contour lines. There are three tints of green up to 200 ft., and above that level browns, red, purple, and white. Altogether nine tints have been used for altitude. There are submarine contours in fathoms with a wide range of blue tints. Rivers and lakes and all names of water features are in blue. Other names are in black. Names have been used sparingly and confined entirely to physical features. The type is small but singularly clear. Numerous spot heights are given. The maps are beautiful examples of cartography and graphic and yet precise representation of the country.

TRIANGULATION IN EAST AFRICA.—A pamphlet, compiled by the Colonial Survey Committee and published by the Colonial Office, gives in collected form the triangulations carried out in East Africa, mainly as the work of various boundary commissions within the last thirty or forty years. The positions on the arc of 30th meridian have been recomputed. The data given are from Kenya, Tanganyika, Uganda, Nyasaland, and northern Rhodesia. A sketch map shows the present state of the triangulation of the 30th meridian in Africa. Between the Egyptian and Uganda arcs is a long stretch which is incomplete, and there is another gap between the Uganda and Rhodesian arcs. A second sketch map shows the state of East African triangulations.

THE JAPANESE EARTHQUAKE OF 1923.—Prof. A. Imamura, in a recent paper (*Japanese Journal of Astronomy and Geophysics*, vol. 5, No. 3; 1928), has studied the seismic history of the Kwanto district, in which the great earthquake of 1923 occurred. The earthquake record, which begins with the year A.D. 416, shows great non-local earthquakes occurred in nearly the same district in 818 and 1703. Further evidence is afforded by the existence of four beach-lines that are well marked by hundreds of deep narrow holes bored by the bivalve *Lithophaga nasuta*. Prof. Imamura connects the lowest beach-line with the earthquake of 1923 and the one above with that of 1703. Assuming the constancy of the rate of boring of the holes, the interval between the formation of the first and third beach-lines would be 1100 years, indicating that the latter was probably connected with the earthquake of 818. Similarly, the date of the fourth earthquake would be about A.D. 33. Thus, during the last two thousand years there appear to have been four great earthquake periods separated by long intervals of quiescence. Lastly, since the yearly number of earthquakes felt in Tokyo was 109 during the years 1903–22, 68 in 1926, and 65 in 1927, it is suggested that the Kwanto district is now approaching a dormant state that may last for a century or more.

ROCK PRESSURE AND FLOWING WELLS.—The Dakota Sandstone in the North Central United States is largely dependent for its water supply on

wells thought to discharge rainwater that percolated underground from the Rocky Mountains. This view is now rejected in contributions on the subject by W. L. Russell on "The Origin of Artesian Pressure," in *Economic Geology* (vol. 23, pp. 132-57; 1928), and O. E. Meinzer (*ibid.*, pp. 262-91). They both conclude that the water is discharged from isolated lenticular masses of sandstone in clay, and is forced to the surface by the weight of the overlying rocks. Under these conditions the future of the supply is less assured than on the theory of hydraulic migration, and the importance of maintaining the supply is leading to the proposal for laws to prevent waste. This case is of special interest, as the analogy with it was the main support to the theory that the flowing wells of East Central Australia are artesian wells. This view was rejected by Gregory ("The Dead Heart of Australia," 1906), who explained their discharge as due to rock pressure and to gas pressure due to the inflow of hot plutonic water into the water-bearing beds. American opinion is now supporting this interpretation, and Meinzer remarks that no one else appreciated the practical importance of rock pressure. The diminution in the flow of the Australian wells which was predicted on the rock and gas-pressure theory has happened, and has led to legislation to prevent the increase in the number of the wells or the waste of their water. It is now recognised that similar legislation is desirable in the United States.

PLIOCENE AND PLEISTOCENE TERRACES.—A Conference on the correlation of the Pliocene and Pleistocene terraces of north-western Europe has been arranged by the International Geographical Union now meeting at Cambridge. Attention has been directed to this question by the work of General Lamothe and Prof. Depéret. In preparation for this discussion a series of papers has been collected on Pliocene and Pleistocene terraces, and issued by the Commission of the Union dealing with this subject (Secretary to the Commission, University Museum, Oxford). The terraces of the Mediterranean basin, of the coasts of France and Spain, and of the British Isles are discussed, with contributions also on those of the Euphrates, Indo-China, Sierra Leone, and South Africa. If Prof. Depéret be correct, and the terraces [are] due to a general rise and fall of the sea, the terraces in different areas should be at the same levels. Prof. Depéret recognises that in parts of the Mediterranean the terraces have been tilted; but he claims that despite such exceptions the bulk of the raised terraces are due to the lowering of the sea and not the rise of the land. The papers in this report [sho]w that the terraces are variable both in height [and] distribution. Thus a paper by Dr. Hume and H. Little points out the absence of modern raised [bea]ches along the Egyptian-Mediterranean coast, [tho]ugh they are well marked at various levels on the [Re]d Sea coast; a paper by Mr. V. A. Eyles shows [the] extent to which the Scottish terraces vary in [hei]ght when followed along the coast. The nature [and] height of the terraces are still inadequately known. [The] studies included in the report give much detailed [and] precise information, and valuable summaries of [the] work that has been done on the coasts both of [Eu]rope and Africa.

[T]HE COSMIC RAYS.—Some new measurements of cosmic radiation are described by Prof. Millikan [and] Dr. Cameron in the June issue of the *Physical [Re]view*, and are discussed by them in the *Proceedings* [of] *the National Academy of Sciences* for the same [mo]nth. Improved experimental methods have been [use]d at the Arrowhead and Gem lakes in California, [and] they now find that the absorption curves of the rays in water indicate that at least three bands of frequencies are present, with absorption coefficients of 0·35, 0·08, and 0·04 per metre of water, the last corresponding to a wave-length of 8×10^{-5} A., or a generating potential of 150 million volts. Nothing important is present between the softest cosmic band and the hardest known gamma rays, and they conclude that there are no possible transformations capable of yielding rays of this enormous penetrating power except those accompanying the building up or creation of the abundant elements like helium, oxygen, silicon and iron out of hydrogen, or in the case of the last two, out of helium. Even then it is necessary to assume that the aggregation takes place in a single process, and not step by step, and by using Dr. Aston's recent accurate measurements of atomic weights in conjunction with the Dirac absorption formula, they show that the three bands, in order of decreasing frequency, agree closely with what would be expected on relativity theory from the annihilation of mass accompanying the formation of magnesium and silicon from hydrogen, oxygen and nitrogen from hydrogen, and helium from hydrogen, respectively; a small residual effect may be due to iron. "The whole work," in their opinion, "constitutes very powerful evidence that atom-building processes are continually going on, and that each event is broadcast in the form of the appropriate cosmic ray."

EXPERIMENTS ON TRANSMUTATION.—In 1907, Ramsay found that solutions of copper salts after exposure to radium gave spectroscopic evidence of the presence of lithium, and he suggested that transmutation of the copper had occurred. Repetition of these experiments by other workers using platinum apparatus failed to confirm this result, and it was thought that probably the lithium was derived from the glass apparatus originally employed. Further work on the effect of exposure to radium is described by J. N. Friend in the *Journal of the Chemical Society* for May. Barium sulphate, pure silver, and pure gold foil were exposed to radium, the spark spectra being afterwards examined and compared with those of an unexposed sample of the same material. No change was noticed except in the case of the gold, when two C calcium lines appeared and the copper lines of the blank became more intense. The experiments were repeated, using a silica tube instead of a glass one, but without consistent results. The changes in the spectra appeared to be due to the presence of impurities irregularly distributed in the original materials. (See also NATURE, July 14, p. 58.)

THE HEAT OF FORMATION OF MOLECULAR HYDROGEN.—The *Journal of the American Chemical Society* for May contains an account of an attempt made by F. R. Bichowsky and L. C. Copeland to determine the heat of association of atomic hydrogen by a direct calorimetric method. Hydrogen was admitted into a discharge tube, where it was partially dissociated into atoms, at a known rate of flow. It then passed through fine holes into a tube containing a platinum calorimeter on the surface of which the atomic hydrogen was catalytically associated, thus causing a rise of temperature. The mathematical theory for the rate of effusion of a gas through a small hole, previously given by Weide and Bichowsky, was used to deduce the percentage dissociation from the difference in pressure of the gas before passing through the holes, before and after the discharge. The value obtained for the heat of formation of molecular hydrogen was $105{,}000 \pm 3500$ calories. Previous values measured by indirect methods range from 90,000 to 107,000 calories.

The National Physical Laboratory, Teddington.

INSPECTION BY THE GENERAL BOARD.

ON Tuesday, June 26, the General Board of the National Physical Laboratory made its annual inspection of the laboratory. As is customary on this occasion, a large number of members of scientific and technical institutions, government departments, and industrial organisations were invited to be present. The visitors were received by Sir Ernest Rutherford, president of the Royal Society and chairman of the General Board; Sir Richard Glazebrook, chairman of the Executive Committee; and the Director, Sir Joseph Petavel.

The activities of the laboratory were well illustrated by an extensive programme of exhibits.

In the Duplex Tunnel a demonstration of wing flutter on a full scale light aeroplane wing was given. The critical speeds at which flutter occurs have been determined in the tunnel and compared with those calculated from the measured elastic and inertia constants of the wing with the help of aerodynamic data derived by the study of a model wing.

In one of the seven-foot wind tunnels tests were in progress on one of a series of symmetrical Joukowsky aerofoils to obtain data on profile drag at high Reynolds numbers. The aerofoil was supported between two stream-lined projections fixed to the tunnel walls and surrounding the supports, the latter being carried through the walls and linked outside to the roof balances by a suitable system of levers. By keeping the gap between the aerofoil and the projections as small as possible, three-dimensional flow at the wing tips was minimised. Measurements were made of the total force on, and the pressure distribution along, the centre section of the aerofoil, with the latter in the position of zero lift. Of interest also was a one-fifth scale model of a new projected variable density wind tunnel by the use of which it is expected that measurements on models of aircraft will be rendered more directly comparable with similar measurements on full scale machines. The tunnel is of the return flow type. To measure the lift or drag, a special form of balance has been devised, in which the balance arm carries a coil forming the movable element of a Kelvin balance. By previous calibration the relation between the current through the coil and the force on the balance arm can be determined. The position of the balance arm is indicated electrically by means of a bridge arrangement, the arms of which consist of two small electromagnets spaced on opposite sides of the balance arm and two windings on the iron core of a moving coil relay. Any movement of the balance arm disturbs the equilibrium of the bridge and produces a deflection of the relay.

In the Engineering Department apparatus for the study of phenomena accompanying fatigue in crystals of aluminium and iron was shown. Large single crystals of either metal can be subjected to reversed direct and torsional stresses, to single blow tensile impacts, and to slow cycles of repeated tensile loading. X-ray analysis permits the positions of the crystal planes with respect to the axis of loading to be determined, and X-ray spectrographic and photomicrographic examinations at frequent intervals during the tests allow the inclinations and nature of the slip bands to be determined.

Another exhibit of interest was apparatus installed for the purpose of determining the efficiency of motor-car transmission gearing. The gear box can float freely and the efficiency is determined by measuring the reaction of the gear box to the motion of the gear train. Apparatus for conducting tests on gear wheels, in which small errors in radial alinement and in pitch of teeth are purposely introduced, was also shown, together with some of the gear wheels examined. In most of these failure had taken place by fracture of a tooth or of teeth near the root and not by abrasion.

Included in the exhibits of the Metrology Department was a new secondary standard barometer designed to give an accuracy between those of the primary and the working standards. To determine the barometric pressure measurement is made, by means of a specially designed micrometer, of the distance between two contacts. One of these consists of a fine platinum wire sealed in the top of the barometer tube and dipping in the upper surface of the mercury column. The other forms the lower end of the micrometer stem and dips into the lower surface of the mercury column. Contact with the mercury is indicated electrically, and the mercury levels can be adjusted by means of a stainless steel plunger supported in an auxiliary tube.

Apparatus for measuring the friction between pivots and jewels was also demonstrated. By means of this apparatus relations between the frictional torque and the load can be determined in terms of the radii of curvature and the elastic constants of the pivot and the jewel.

In order to facilitate the rapid melting of small charges of metals and alloys, a valve-operated high frequency furnace has been installed in the Metallurgy Department. Two thermionic valves, each capable of dissipating two and a half kilowatts at the anode, are employed, and are connected to the A.C. supply in such a way as to permit both halves of the A.C. wave to be utilised. The furnace was being used in connexion with experimental work to remove oxygen from electro-deposited chromium, in which it is found in the form of an insoluble oxide. Removal of the oxygen is effected by maintaining fragments of the metal at about 1400° C. or 1500° C. in the furnace, and at the same time passing over them a rapid stream of purified hydrogen which is circulated in a closed system containing the metal and a purifying train.

A new type of carbon resistor furnace developed in the Department was also on view. The action of the furnace depends on the contact resistance between a number of carbon pellets contained in a refractory and nearly air-tight sheath. The temperatures attainable are limited only by the power of the sheath to withstand the heat developed, and it is found that the pellets remain unchanged for a considerable period of time even when maintained at temperatures approaching 1500° C.

In the Physics Department an investigation was in progress to determine the heat of combustion of carbon monoxide at atmospheric pressure. Oxygen and carbon monoxide are fed from separate cylinders into a special burner fitted in a vacuum walled vessel furnished with flow tubes for the continuous circulation of water. The temperature rise of the water is measured by means of a pair of differential resistance thermometers. The calorimeter is calibrated by replacing the flame by a resistance coil in which a measured amount of electrical energy is dissipated as heat and carried over the cooling tubes by means of a stream of oxygen.

Apparatus for the determination of the thermal conductivity of furnace materials was also on view. The material under test rests on a metal plate heated from beneath by a number of electrical resistors, and on its upper surface is mounted a flow calorimeter

with guard ring. The rise in temperature of the water is measured by means of differential resistance thermometers and the temperatures of the upper and lower faces of the specimen are determined by means of a number of suitably disposed thermocouples.

In connexion with an investigation on cold storage, a vertical closed-circuit air channel has been developed to investigate the laws governing the transfer of heat between the air stream and pipes through which brine is flowing. The speed of the air is controlled and arrangements are being made to use single pipes or batteries of pipes in which a shielding effect comes into play. It is hoped to obtain the conditions governing the maximum transfer of heat with the minimum resistance to air flow. It will be possible to use either dry or moist air in the channel, and in the latter case to investigate the problems of hoar frost deposited on pipes. The presence of hoar frost seriously impairs the transference of heat from the air to the pipe.

A method of determining the acoustical absorbing powers of various materials by means of stationary waves was demonstrated in the Sound Division. One end of a smooth cylindrical tube is closed by a steel disc to which the material is cemented, the other end being open and facing a loud speaker producing a pure note of known pitch. Stationary waves are formed in the pipe and the relative intensities of the maxima and minima for various materials depend on their absorbing power. Measurements of their intensities are effected by means of an exploring microphone.

A recent addition to the Radiology Division consists of a constant voltage generator for X-ray tubes. A transformer, the secondary voltage of which is 100,000, is employed. Full wave rectification is obtained by means of four hot-cathode rectifying valves, and smoothing is effected by suitably disposed condensers and chokes. Power is drawn in at each half cycle, and the transformer is not subjected to any unidirectional magnetic field.

An important addition to the equipment of the Electrotechnics Department consists of new precision current transformers cored with 'permalloy.' By means of this alloy of nickel and iron, which has very high permeability and very small hysteresis loss at very low flux densities, it is possible to obtain currents in the secondary closely proportional to and nearly 180° out of phase with the current in the primary. This is of considerable importance in measurements of power in circuits carrying heavy alternating currents.

A new standard water-cooled tubular resistance capable of carrying 7500 amperes has also been constructed. In the design of this, the aim has been to make the resistance so far as possible independent of the method of connexion to the external circuit, so as not to interfere with the streamline flow of current.

In the High Voltage Building was to be seen the new power equipment for single, two and three-phase high voltage work up to 1,000,000 volts, together with apparatus developed for this work. Mention may be made of a new shielded parallel-plate air condenser of zero phase angle. Three plates are used, the centre one being the high voltage plate and the two outer ones being earthed. To avoid corona effects, the edges of the plates are curved, the degree of curvature being so adjusted that the potential gradient round the edges is not greatly in excess of that between the plates.

Among the exhibits in the Electric Standards Division was a screened bridge for the measurements of inductance, capacitance, and effective resistance at radio-frequencies. It is essentially a Schering bridge, consisting of two equal resistance arms and two capacity arms, one of the latter being the unit under test. The bridge is balanced by means of variable condensers shunting each resistance arm. The complete apparatus consists of the bridge proper, a local source of radio-frequency supply to the bridge, a screened detector and amplifier, and a local screened oscillator to heterodyne the oscillations from the bridge.

Of interest also was apparatus for the study of the vibrations of quartz oscillators. Interference patterns are obtained when monochromatic light is reflected from the flat polished surface of the crystal after previous transmission through an optical flat. Any vibration of the crystal leads to blurring, except at the nodes, where the appearance of the interference bands remains unaltered.

The Wireless Division exhibited a new portable self-contained transmitter for use with wireless direction finders. It is operated by a 12-volt battery, the anode voltage of 300 volts being supplied by a generator operated by the battery. An Eccles two-valve circuit with interchangeable coils for wave-lengths from 30 metres upwards is used. A portable mast, adapted for mounting on a motor-car, completes the equipment. A small laboratory short-wave transmitter for wave-lengths of 5 metres and upwards has been developed for the study of wave propagation. In this oscillator two valves are arranged on the 'push-pull' principle with variable capacity coupling between the anode and grid coils.

The efficiency of light wells in building blocks is a matter of considerable importance in illuminating engineering, and a model light well has been constructed in the Photometry Division to permit such determinations to be made. The breadth and depth of the well are fixed, and seven different-sized sky openings can be provided by adjusting the sizes of the other two walls. A number of selected points are taken in the middle vertical line of one of these walls, and at each point the ratio of the illumination on the wall to that falling on the sky opening of the well is determined. By this means wells of different size and using paint of varying reflection factor can be directly compared. An artificial sky is provided in order to approximate to actual conditions, and the well is fitted with a matt black floor.

Mention should also be made of a precision illumination photometer of the Macbeth type. This embodies the usual Lummer-Brodhun photometer head, and is fitted with internal screens between the head and the comparison window to minimise the effect of stray light from the tube walls. The comparison lamp is enclosed in a small whitened chamber equipped with a window, in order to eliminate errors due to internal reflection in the comparison lamp bulb. The instrument operates on the inverse square principle, and its constant can be varied by the insertion of stops in front of the translucent window. Precise control of the comparison lamp current, an important item, is provided by including the lamp in a Wheatstone bridge circuit, of which it forms one arm.

In the William Froude Tank a self-propelled model of a merchant ship was run at intervals through a series of regular waves. The model, which was electrically driven, was fitted with self-recording mechanism, by means of which the propeller thrust, torque, revolutions, and time were automatically determined, while in the main carriage generally used for towing models, the pitching and rolling of the vessel could be recorded by means of a lever system operating suitable recording mechanism, once the speeds of the model and the carriage had been synchronised. The work forms part of a research on the influence of waves on the resistance and propulsion of ships.

The Empire Marketing Board and Scientific Research.

THE second report of the Empire Marketing Board, covering the period May 1927–May 1928, which has just been published by H.M. Stationery Office (price 1s.), is a further indication of the importance which the Home Government now attaches to scientific research in connexion with the development of the resources of the Empire. The Empire Marketing Board was established in 1926 for "the furtherance of the marketing of Empire produce in the United Kingdom," and realised from the first that success depended largely upon the support given to scientific research and economic investigations and their extension to new fields. In last year's report the Board could only indicate its first approaches to the network of problems with which it was faced. Its tentative policy had still to be endorsed by the British overseas governments. It had still to stimulate those governments to create the necessary local machinery for the co-ordination of research and the application of newly won knowledge to the better production and marketing of Empire crops.

In the present report the Board is able to record substantial progress, and while it is true that the greater proportion of its grants for research is still being made to institutions in Great Britain—because their comparatively advanced stage of development fits them for undertaking research work of general application—in the past twelve months it has been able to extend its grants to other countries and to new fields of science. The Imperial Agricultural Research Conference assisted the Board in this direction.

Details are given in an appendix to the report of the new schemes which the Empire Marketing Board is committed to support. Provision has been made for a grant of £22,000 per annum towards the cost of a Colonial Advisory Council of Agriculture and Animal Health, and the formation of a Colonial Agricultural Service with a specialist wing for research work and an agricultural wing for administrative work, conditional upon five times this sum being provided by colonial governments. A capital sum of £18,500 has been provided for chartering and equipping two trawlers to carry out investigations, under actual sea conditions, into the handling of fish at sea with the object of improving methods of preservation. A new station is being erected at East Malling for cold storage experiments on a semi-commercial scale in connexion with fruit. £30,000 is to be expended on adequate accommodation for the Department of Entomology at the Natural History Museum, and £12,000 on the erection of a new building to house the Imperial Bureau of Mycology upon a site which will enable it to retain its close connexion with the Royal Botanic Gardens at Kew. The government of Southern Rhodesia is now a participant in the scheme for the investigation into the mineral content of natural pastures, with special reference to soil deficiencies and their effect on the growth and strength of live-stock. The Ontario Agricultural College at Guelph is receiving a grant on a pound for pound basis for poultry research. A Plant Breeding and Seed Research Station is being established at Palmerston North in New Zealand. The government of Sierra Leone is being assisted to establish an experimental fruit farm in connexion with bananas and grape-fruit, and the Fiji government is being encouraged to undertake an investigation aiming at the improvement of methods of cultivation, handling, drying, and grading of copra.

Among other new projects for which grants have been made are: a geophysical survey of certain areas in Australia; the Great Barrier Reef Expedition; researches into the fundamental problems of sheep-breeding and determination of effective standards of raw wool to be carried out at the Animal Breeding Research Department, Edinburgh, and the Research Association for the Woollen and Worsted Industries, Leeds; an investigation into the nature of the variations in the vitamin content of cod-liver oils. The Empire Marketing Board is to be warmly congratulated on the manner in which it has disbursed its funds for the past two years.

University and Educational Intelligence.

MANCHESTER.—The following appointments have been made in the Faculty of Technology: Mr. H. V. Lowry to be lecturer in mathematics; Mr. Thomas Bevan to be lecturer in mechanical engineering; Mr. Horace Spibey to be assistant lecturer in spinning; Mr. N. W. Coe to be assistant lecturer in mechanical engineering.

MR. F. H. REID, formerly of Northampton Polytechnic and now head of the Engineering Department at Sunderland Technical College, has been appointed head of the Engineering and Building Trades Department of the Borough Polytechnic, London, S.E.1. He will succeed Mr. G. E. Draycott, who is retiring at the close of the current session after thirty-one years in south London.

THE Governors of Loughborough College, Leicestershire, invite applications for the award of five open scholarships in the faculty of engineering, each of the annual value of £75. The scholarships are open to British subjects situate in any part of the Empire, and are tenable at Loughborough College for the period of the full diploma course. Further particulars and application forms may be obtained from the College Registrar, to whom all forms of application must be returned not later than Mar. 28, 1929.

A NEW publication, *Wessex*, is not, as its name might imply, to deal at large with the area denoted by the name of the old Saxon kingdom resuscitated by Thomas Hardy. It is "an annual record of the movement for a University of Wessex based on University College, Southampton." It has been produced by members of the staff, students and friends of the College, and in part is devoted to descriptive accounts of the work of its academic departments. The greater part of the first number, however, is taken up by articles of a more general interest, some, but not all, of a local flavour. While Mr. O. G. S. Crawford deals with "Wessex," for example, Sir Mark Hunter discusses the ending of Shakespearian tragedy and Prof. E. W. Patchett reproduces a lecture on Faust. Two subjects, however, inevitably loom large, one the movement for a University of Wessex, on which Dr. C. G. Montefiore and Principal Vickers write, and the other Thomas Hardy, who was himself keenly interested in the movement. His life, work, and influence are here considered from many sides in a number of articles by personal friends and others. In the appeal for funds for the University, it is stated that a sum of somewhere about half a million will be required to provide building, equipment, and endowment—a very moderate sum when everything is taken into consideration and having in view the objects which it will be possible to achieve in an area which, at present, is but poorly served intellectually. Appeals to the purse of the public are numerous, but few are more worthy of support or more likely to repay the generous benefactor than this need of Wessex.

Calendar of Customs and Festivals.

July 23.

THE DEATH OF ST. BRIDGET.—On the eve of St. Bridget every farmer's wife in Ireland made a cake called 'Bairinbreac,' and the neighbours were invited to a feast. The custom has been compared to that of the Hebrew women of burning incense, pouring out drink offerings, and offering cakes baked with their own hands to a female deity. Certain clay cakes of various forms recently found in the excavations at Beisan are conjectured to be such offerings in their ceremonial guise.

July 24.

ST. MARY MAGDALEN.—It was usually a part of the marriage contract among the peasants of Provence that a husband should visit the shrine of St. Mary Magdalene in the Grotto of St. Beaume, near Marseilles, with his wife in the first year of marriage, and even if the visit were not stipulated, neglect was a slight on the wife. A visit to a prehistoric monument, a shrine, or in Ireland a saint's "bed," is a widespread cure or preventive of barrenness.

ST. DECLAN (fifth–sixth centuries), Bishop of Ardmore and Patron of Decies, reputed, but probably incorrectly, to have been a disciple of St. Patrick. At his birth a globe of fire blazed on the house in which he was born. At one time he and his companion were borne in a magic boat which crossed the sea without sail or oar. Not only were his black (iron) bell, which had been sent from heaven, and his vestments conveyed over sea on a floating rock, but this rock preceded his ship as a guide to Ardmore, where it floated ashore and afterwards served as one of the objects in his cult. On one occasion as many as eleven hundred persons crawled under it on his feast day to be cured of diseases and especially pains in the back. The pilgrims then washed in and drank of his well, and finally carried away a handful of the earth from his grave, to which magical properties were attributed.

ST. BEOC, MOBHEOG, or DOBHEOG, especially associated with the Island of Saints in Lough Derg. There was St. Patrick's Purgatory, a cave, entrants to which suffered grievous pain, but saw wondrous visions. Monuments such as St. Patrick's Bed and St. Beoc's Seat, as well as popular pilgrimages attended by large numbers, point to an early cult. St. Patrick's Purgatory was specially mentioned in the legislation under Queen Anne suppressing well-worship and similar customs. Similar caves are frequently mentioned, for example, that in which Grania and Dermod took refuge, on the Hill of Howth, and the one at Baltinglass in which Croghan disappeared. The references are to the characteristically Irish underground structures known as *souterrains*.

ST. CHRISTINA, a maiden of Tyre, aged eleven, whose father Urbanus enclosed her in a high tower in which he placed gold and silver gods and twelve servant maids in order that she might consume her time in worship and be free from the attention of ardent lovers. But she came to adore the god of the heaven she could see through her windows. An angel from heaven bade her not to fear, made the sign of the cross on her forehead, and left with her a loaf of white bread. A similar story is told of Asenath, daughter of Potiphar, high priest of On, who, despising all men, lived in a high tower, worshipping her gods of gold and silver until she saw Joseph, who taught her of the true God.

The story of the maiden who is shut in a high tower to preserve her from the attention of undesirable lovers is familiar in the folk-lore of many countries. The lover reaches the maiden finally by scaling the tower, or sometimes in the shape of a dove or an eagle. Zeus visited Danae as a shower of gold. Sometimes the damsel is impregnated by a ray of the sun, just as Christina's angel came from heaven. The mention of the sun connects the story with the well-known primitive custom of confining girls at puberty in darkened huts or veiling them from the rays of the sun.

July 25.

ST. JAMES.—In the "Manuale ad Usum Sarum" of 1555, a blessing on the new apples is prescribed for this day in a formula which refers to the punishment which followed the eating of the forbidden fruit by our first parents, and asks that by this solemn ceremony we may be enabled to eat of the fruits of the earth without harm. The priest is then to asperge the apples with holy water.

The blessing or purification of the apples is not solely due to a primitive fear of doing anything for the first time. Both the sin of the forbidden fruit and the blessing are connected with the breaking of a taboo. The ceremony is intended to divert the consequences which in the Bible story are made to follow the infraction of the taboo. New crops are full of spiritual influence which may be, or indeed is, harmful to man. They must not be touched until they have been rendered harmless. Either they represent the deity of the crop himself or they lie so peculiarly in his province as to be sacrosanct until he has been propitiated. The taboo is removed by a sacrificial meal of the worshippers or, when the personality of the god has been dissociated from the material crop, by libations and offerings or by a purificatory ceremony. This is the idea underlying all first-fruit offerings, harvest thanksgivings, and purificatory or dedicatory ceremonies. While the rogation ceremony renews and builds up the spirit or power of the deity in the fields and the crops, the harvest festival, in one aspect at least, breaks it down.

The popular cult of St. James at the famous shrine of St. Iago de Compostella in Spain appears to be a survival of a pagan cult associated with the prehistoric monuments in the neighbourhood. St. James is also associated with the cult of Our Lady of the Pillar at Saragossa, whose image is said to have been set up by him. This may indicate what was once a joint male and female cult.

July 27.

THE SEVEN SLEEPERS, who, suffering persecution under Decius, were walled up in a cave and awakened 372 years (actually 180 years) after under Theodosius. There are many versions of this story current in medieval times, in some of which the pagan origin is clear. William of Malmesbury records a belief that the sleepers turn on their sides when sorrow threatens.

July 28.

ST. SAMSON of Dol, in Brittany, a Welsh saint who spent some considerable part of his life in Armorica. His anger at finding Bretons dancing around a stone pillar on a hill, even when he was told by their chief that they were not practising magic, but amusing themselves, indicates the importance of the stone monument as the centre of pagan cults in early Christian times. The saint marked a stone near by with a cross, a frequent method of dealing with such cult objects. A variant places this incident in

Societies and Academies.

LONDON.

Optical Society, June 14.—**T. Y. Baker**: The errors of a reflecting prism. A prism with two reflecting faces designed to fulfil a particular purpose in an optical instrument gives rise to errors due to (*a*) inaccuracy of manufacture, and (*b*) inaccuracy in mounting the prism in the instrument. The effects of these errors are investigated.—**W. D. Wright**: A trichromatic colorimeter with spectral primaries. A spectrometer system is used in which two spectra are formed from the same source. From one, three portions to act as primaries are reflected back through part of the dispersing system, so that the mixing of the three radiations is effected by neutralising the prismatic dispersion by which the colours were first separated. From the other, the test colour and a desaturating colour are selected and mixed in a similar manner, and the composite beams are then brought into a simple bipartite field. The Maxwellian method of observing the field of view has been adopted without the introduction of rotating parts into the system, and special precautions have been taken to remove stray light.—**T. Smith**: (1) The theory of aplanatic surfaces. The necessary and sufficient condition that an optical system should have a pair of aplanatic surfaces is that the eikonal of the system can be expressed as a homogeneous function of the first order in three variables. Methods are given for finding the equations of these surfaces when the eikonal is given and for finding the eikonal when the surfaces are given. In general, only one pair of aplanatic surfaces is possible, but in spherically symmetrical systems two pairs are found. (2) The primordial coefficients of asymmetrical lenses. An easily calculable system of sixteen magnitudes is constructed for the representation of the properties of asymmetrical lenses. All equations are expressed in matrix form and an account of the elementary properties of matrices is included. (3) Note on the use of lenses in series for sight-testing. The series arrangement enables a small number of lenses to be combined to give the correction for any regular defect of form. In general, effective powers are not simply additive, but under certain conditions the error made in regarding them as additive becomes small. With incorrect arrangements serious errors may be made.

Royal Meteorological Society, June 20.—**J. Edmund Clark, I. D. Margary, R. Marshall,** and **C. J. P. Cave**: Report on the phenological observations in the British Isles, December 1926 to November 1927. As frequently of late, early warmth, inducing also early bloom on fruit trees, was precursor of destructive cold spells in April, May, and even early June, when sunless drought prevailed as well. Then followed a wet, cool, sunless summer. On all coasts the sea was coldest in February, warmest in August; in the west and south colder in May than November. The mean flowering date was actually early, though after May practically all were late. The early migrants, on the other hand, were retarded two days; the later were a day early. The final results for farming were bad; in many parts, especially in north-east Scotland, disastrous. Only apples and raspberries gave a good fruit crop, but the exceptional wet coolness gave a wealth of herbaceous blossom. October was the only redeeming feature in the latter half of the year.—**C. K. M. Douglas**: On the relation between temperature changes and wind structure in the upper atmosphere. (*Mem.* No. 7, vol. 1.) Assuming that the wind velocity is 'geostrophic,' it is known that the horizontal gradients of temperature in the free air can be deduced from the variation of wind with height at a given time, and the temperature changes due to purely horizontal movements readily follow. A comparison is made between the temperature changes thus calculated and temperature changes observed during the years 1920–25 inclusive. The correlation between observed and theoretical changes is a little less than 0·5, both for 6-hour and 24-hour time-intervals, but is higher for large temperature changes.—**R. M. Poulter**: Simple formulæ for computing relative humidity. Formulæ are given for the calculation of relative humidity from readings of dry and wet bulb thermometers without reference to tables. For air temperatures around 60° F. the 'relative dryness' of the air is given by

$$\frac{1000}{3} \times \frac{\text{depression of the wet bulb}}{\text{dry bulb reading}}.$$

The required relative humidity is given by subtracting this 'dryness' figure from 100. Slight modifications of the factor 1000/3 provide for a range from below freezing point to about 120° F. The formula can be adapted to Centigrade readings simply by adding 17·8 to the dry bulb reading before making the computation.

DUBLIN.

Royal Irish Academy, June 25.—**E. T. S. Walton**: On the motion of vortices near a circular cylinder in a stream of liquid. The cases of a single vortex and also of a symmetrically placed vortex pair near a circular cylinder in a stream of liquid are investigated. The equations of the paths of the vortices are given and their nature discussed.—**J. Doyle** and **P. Clinch**: (1) Further notes on the metabolism of conifer leaves. The groups of the Coniferales are characterised by definite *p*H values; Abietineæ, Taxodineæ, and Araucarineæ about 3·7, Cupressineæ and Taxaceæ, as a whole, about 5·1. *Sciadopitys* is an interesting exception in its group. No further relation could be established between *p*H and water-soluble pentosan content. The only oxidising enzyme demonstrable was peroxidase, which seems always present although sometimes masked by an inhibitor, the nature of which has to be analysed. It fades on standing and, though associated with tannin-like substances, seems of a different nature. Autoxidisable substances yielding peroxides are present, their oxidation being normally inhibited by tannins. (2) The catalase content of conifer leaves, with notes on its measurement. The catalase activity of a number of conifers shows a low summer level, rising to a maximum in December and January, and falling again in spring. These findings are directly contrary to those reported by Burge. The wide individual and seasonal variations lend no support to the use of catalase as an index of respiratory activity, although the seasonal variations correspond closely to seasonal variations in starch content already reported. A method is described in which the initial rate of a catalase reaction can be measured and fast reactions followed. The initial rate is proportional to catalase concentration over a wide range, and is proportional to peroxide concentration when dilute, becoming steady with increasing concentration. There is a latent period which varies both with catalase and peroxide concentration. Both at 20° C. and 30° C., variations in the early course of the action seem constant. The initial rate is fast, falls off rapidly, increases again, remaining steady for some time, once more falling off in the normal manner of an enzyme action.

EDINBURGH.

Royal Society, July 2.—**J. R. Wilton**: The lattice points of a circle. A great deal of interest has of late years centred round the arithmetical function $r(n)$, defined as the number of integer solutions of the equation $p^2+q^2=n$, so that, for example, $r(1)=4$, the four solutions being $(0,\pm 1)$ and $(\pm 1, 0)$. In the great majority of cases the problems considered have been connected with the sum-function

$$R_2(x)=\sum_{n=1}^{[x]} r(n)$$

which is evidently equal to the number of lattice points (*i.e.* points with integer co-ordinates) within and on the circle of radius $\sqrt{x}$, but excluding the centre (the origin). In the present paper a new formula is formed for the function $R_2(x)$.—**H. W. Turnbull** and **J. Williamson**: The invariant theory of the quaternary quadratic complex (Part 2). The complete system. This communication illustrates methods proposed in the earlier part, by giving a list from which all possible invariants can be constructed.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Jan. 20.—**C. G. Joh. Petersen**: Some biological principles. The true biology may, beside the mechanistic viewpoint, use the 'whole' in the provisional description. The physical qualities of the organisms do not belong to true biology but to psychology (*v.* NATURE, July 14, p. 68).

Feb. 17.—**Jakob Nielsen**: The fixed point problem in the representation of closed planes. Constant representation of planes of order 0 or 1 can be conceived as generalisations of analytical transformations, and the same applies to the related fixed point problem. For planes of higher order, this is no longer true, since the problem can at present only be stated from the topological viewpoint. The treatment is connected with fundamental problems of group-theory.

ROME.

Royal National Academy of the Lincei, Mar. 4.—**L. Tonelli**: The definition of the function of two variables with limited variation. In recent communications, Nalli and Andreoli have treated of the definition of the area of a surface, and have arrived at a definition of a pair of functions of two variables with limited variation. Moreover, by applying the general results obtained to the surface given in the form $z=f(x,y)$, they deduce a definition of the function of two variables with limited variation. The relation of such a definition to that given by the author two years ago is now considered.—**U. Cisotti**: An interpretation expressive of the conditions of Saint-Venant on infinitesimal variations.—**N. Parravano** and **G. Malquori**: The reduction of silver sulphide by means of carbon. The method recently used for the study of the equilibrium between sulphur and molybdenum trisulphide is now applied to measure of the pressure of carbon disulphide corresponding with the reaction $2Ag_2S + C = 4Ag + CS_2$ at 1015° and 1050°.—**L. Rolla** and **L. Fernandes**: Fractionation of neodymium-samarium mixtures. Crystallisation of the double nitrates formed with magnesium and with manganese furnishes an excellent method for the separation and purification of neodymium from samarium and vice versa.—**A. Russo**: The varying chromosomic equipment of the cells of Metazoa in relation to sex and the difference in category between mixed individuals and pure gametes in *Cryptochilum echini*. In metazoa, with a greater amount of nuclear substance, determined by the presence of a chromosome or of several differential chromosomes, there corresponds the development of a female individual, whereas with less nuclear matter, depending on the lack or smallness of these chromosomes, there corresponds a male individual. Similarly, in *Cryptochilum* the difference in quantity of nuclear substances between the individuals of the two categories is the index of their different nature, only that it is determined during the conjugation of the gametes, since one-fourth of the micro-nucleus of the gamete A migrates to the gamete B, where a third mitosis takes place to furnish the mixed individual B with two nuclei, which are equal to one-half of those of the mixed individual A.—**P. Nalli**: The parallelism of Levi-Civita and certain possible extensions.—**L. Fantappiè**: The linear functionals of the functions of two complex variables (2).—**L. Martinozzi**: A new model of condensation hygrometer. Ranzi has directed attention to a source of error affecting hygrometric measurements made with condensation hygrometers of the types devised by Regnault, Chistoni, and others, in which the cooling is attained by evaporation of ether in the vessel containing the thermometer bulb. No matter what precautions are taken, the temperature of the bright surface may differ from that of the thermometer bulb by as much as 1° C. Such error may be avoided by making the thermometric body identical with the wall on which the dew is deposited. In the instrument devised by the author, the thermometer body consists of a bimetallic strip of silver and invar steel arranged cylindrically. One edge of the strip—along a generatrix of the cylinder—is fixed to a vertical aluminium column, while to the free edge is fastened by means of screws a rod, which, by a system of levers like that used in registering apparatus, moves a long index over a scale.—**G. Todesco**: A new method for observing very small double refraction. A highly sensitive method for observing slight double refraction of accidental, magnetic, or electrical origin is based on the use of a photo-electric cell, arranged to receive the light which, by interposition of the doubly refracting body between two crossed Nicols, emerges from the analysing Nicol. The use of such a cell not only renders it possible, owing to a convenient system of amplification, to detect extremely small variations in luminous intensity, but also removes the causes of error and uncertainty involved in naked eye methods, and gives a numerical result (galvanometer reading).—**M. Pierucci**: Influence of the electric charge on the conductivity of a metallic film.—**G. Natta** and **M. Freri**: X-ray analysis and crystalline structure of cadmium-silver alloys (3). Investigation of cadmium-silver alloys, rapidly solidified and tempered by the powder method, reveals a region of α-solid solutions of cadmium in silver, having the lattice of the latter, but deformed regularly according to Vegard's law up to 35 per cent of cadmium. The α-phase occurs in alloys with 0·45 per cent of cadmium, and the side of the elementary cell increases from 4·07 to 4·15 A. A compound AgCd exists, which has a body-centred cubic lattice and forms with the components β-solid solutions, these being present in alloys with 47-55 per cent of cadmium; the elementary cell has a side increasing from 3·32 to 3·34 A., and contains one molecule, the calculated density being 9·97 to 9·82. Alloys with 55 to 65 per cent of cadmium are composed of solid solutions of a new phase of complex structure similar to the body-centred; the elementary cubic cell of side 9·96 A. contains 52 atoms, *i.e.* 4 molecules of the compound Ag_5Cd_8. With 65-95 per cent of cadmium, a simple compact hexagonal structure appears, the side varying from 3·04 to 3·09 A., and

the value of $c : a$ being 1·58; these are perfect solid solutions of cadmium and silver in $AgCd_3$. Alloys with 95-100 per cent of cadmium are solid solutions of silver in cadmium, and have the lattice of the latter. The compound AgCd is dimorphous and is transformed below 420° into a compact hexagonal modification with $c : a = 1·62$ and $a = 3·01$ A.—**G. Scagliarini** and **E. Brasi**: Additive compounds of halides of divalent metals with organic bases (5). Six compounds of mercuric halides with hexamethylenetetramine have been prepared.—**Giambattista Dal Piaz**: The geology of the Grivola group.—**G. Cotronei**: Factors of morphogenesis in successive times of development.—**E. Benedetti**: Experiments on the amplification and detection of bio-electric currents by the use of thermionic valves.—**U. D'Ancona**: Preliminary notices on the larval states of Murenoids collected by Prof. Luigi Sanzo in the Red Sea and in the Gulf of Aden during the cruise of the Italian naval ship *Ammiraglio Magnaghi* in 1923–24.

SYDNEY.

Linnean Society of New South Wales, April 27.—**F. H. S. Roberts**: A revision of the Australian Bombyliidæ (Diptera). (Part I.) Two subfamilies are dealt with, the Exoprosopinæ and the Anthracinae. Five genera are placed in the former subfamily, one being described as new. Only one genus belonging to the Anthracinæ occurs in Australia, namely, *Anthrax*. Altogether forty-six species are described, eighteen being regarded as new.—**C. P. Alexander**: Crane-flies (Tipulidæ, Diptera) from Barrington Tops, N.S.W. Description of forty-five species taken at a height of approximately 5000 feet during January 1925. Twenty species and two subspecies are described as new.—**Rev. H. M. R. Rupp**: A review of the Australian species of *Corysanthes* (Orchidaceæ). Recognition is sought for seven valid species of *Corysanthes* for Australia. The confusion between certain species in the past dates back at least to Hooker's time. The difficulties of determination are really confined to *C. fimbriata*, *C. diemenica*, and *C. pruinosa*. *C. undulata*, rediscovered in 1924 after being lost for ninety-one years, is clearly a valid species, and the remaining two are very distinct.—**A. B. Walkom**: Fossil plants from Plutoville, Cape York Peninsula. Description of a small collection of plants which indicate a Cretaceous age for the rocks in which they occur. Eleven species are described, three being new. Two are doubtfully referred to *Lyncopodites*, the first record of the genus from Queensland rocks.

VIENNA.

Academy of Sciences, Feb. 16.—**W. J. Müller** and **O. Löwy**: The theory of passivity phenomena (2). The relation between passivity current-density and time. The curve is a straight line if time and current-density are plotted logarithmically. The surface layer for iron in ferrous-ferric sulphate or in normal sulphuric acid is ferrous sulphate heptahydrate. Experiments were made with protected, with free-hanging and with agitated electrodes.—**S. Strugger**: The influence of hydrogen ion concentration on the protoplasm of root hairs in *Hordeum vulgare*. A three-peaked curve was found with maxima for flocculation at pH 6·85-6·90, 7·00-7·05 and 7·35. The percentages of hairs with inhibited plasma streaming gave the same three-peaked diagram.—**F. Urbach**: On sols in crystals (1).—**N. A. Puschin**, and **D. König**: Equilibrium in binary systems containing urea as one component.—**O. Gugenberger**: Some new cephalopods from the Carnic-Noric mixed fauna of Feuerkogel near Aussee.

Feb. 23.—**E. Steinach** and **H. Kun**: The secretion of the male gonad and its dependence on the hormone of the frontal lobe (hypophysis or pituitary). Experiments on infantiles, eunuchoids and seniles. Rats were used. With rats the developmental action of the testicle secretion sets in relatively late, in the ninth or tenth week of infantile life. Tests were made with extract or hormone solutions from the pituitary of rats or cattle, applied by injection. Rats of the same litter were used as controls. The activating impulse for the testicle secretion comes from the pituitary. Pituitary extract provokes bodily and mental precocity.—**L. Schmid** and **A. Waschkau**: The constitution of anthochlor from yellow dahlias. Apparently a flavone, possibly 1, 3, 4-trioxyflavone; melting points agree with apigenin.—**L. Schmid** and **M. Zentner**: Dehydration experiments on sitosterin. Dehydration of cholesterin by palladium gives a similar but not identical hydrocarbon.—**L. Schmid** and **G. Bilowitzki**: Researches on plant sterines. Stigmasterin and sitosterin were found; in *Ulmus* chiefly stigmasterin, in *Ficus* sitosterin, in *Bardana* both sterins.—**L. Schmid**, **A. Waschkau** and **E. Ludwig**: Alkali compounds of polyvalent alcohols and carbohydrates.—**L. Schmid** and **M. Zentner**: Methylisation of starch.—**L. Schmid**, **E. Ludwig**, and **K. Pietsch**: Cryoscopic determinations of the molecular weight of glycogen in liquid ammonia. A value of about 180 points to the presence of a hexose anhydride. A platinum resistance thermometer and mirror galvanometer were used.—**R. Andreash**: Rhodanine and related compounds. Rhodanine gives thiazol derivatives on reduction.—**E. Göllnitz**: Contributions to the theory of quaternions.—**A. Kieslinger**: Geology and petrography of the Kor Alps (6). Pegmatites of the Kor Alps.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 4, April).—**Burton E. Livingston**: Dynamic relations between plant and soil, with special reference to the supply of water and oxygen. The living plant and its environment are regarded as two members of a system, the former allowing material and energy to pass in or out and the latter supplying material and energy. The environment should be described in terms of its power of supplying or removing material and energy. Of the soil conditions, only its supplying powers for water, oxygen, and carbon dioxide have been studied. At Baltimore in summer, a square metre of absorbing root surface (lawn plants) requires 80 gm. of water and 3 mg. of oxygen per hour.—**Cecilia H. Payne**: On the distortion of the continuous background by wide absorption lines. The continuous backgrounds of the spectra of all stars with strong Balmer lines are distorted in the ultra-violet. Temperature measurements, therefore, should not be based on this region; the phenomenon also affects the colour indices.—**E. Bodewig**: A case of streaming in a valve. The pressure of water against a trap-valve as a two-dimensional problem.—**S. Satina** and **A. F. Blakeslee**: Studies on biochemical differences between sexes in Mucors. (5) Quantitative determinations of sugars in (+) and (−) races. The amounts of reducing and total sugars were greater in the (+) races of 74 per cent of the pairs tested and the non-reducing sugars in the (+) races of 66 per cent of the pairs. The amount of reducing sugars found is not sufficient to account for the reduction of potassium permanganate previously demonstrated for (+) races, but the difference of sugar content in (+) and (−) races is believed to be significant.—**C. J. Davisson** and **L. H. Germer**: Reflection of electrons by a crystal of

nickel. The electron beam is directed against a {111}-face of the crystals at various angles of incidence, and the intensity of scattering in the incidence plane is measured as a function of bombarding potential and direction. A sharply defined beam of scattered electrons in the direction of regular reflection is obtained whenever the speed of the incident electrons is within a certain range which varies with the angle of incidence. Within each range is an optimum speed giving maximum reflection. The phenomenon is analogous to the selective reflection of X-rays and in accord with the authors' earlier experiments on electron diffraction.—**Arthur Edward Ruark**: (1) The limits of accuracy in physical measurements. There appear to be definite limits to the accuracy of measurements of length, time, and momentum in single experiments. Statistical results seem to give more information than individual experiments, but they depend on the questionable assumption that the structure of particles is definite and independent of their past history and conditions. (2) A critical experiment on the statistical interpretation of quantum mechanics. The probability functions are considered as referring (*a*) to the average behaviour of a number of similar systems, or (*b*) to individual systems having a group effect, such as an atom existing in several quantised states at once. Counts of the γ-rays emitted by radium-*B* or -*C* would, in case (*b*), show that two or more γ-rays were emitted simultaneously from a single atom. Present experimental evidence is against this view.—**David L. Webster**: (1) Direct and indirect characteristic X-rays: their ratio as a function of cathode ray energy. Earlier work on this subject has been extended, the target consisting of a cadmium block plated with silver or wrapped in silver foil being replaced by a cadmium block with cylindrical surface across which was stretched the silver foil, under tension and backed by aluminium foil. The ratio of the intensity of the K_a lines of silver and cadmium gives a measure of the ratio of the direct to the total indirect rays. For silver this ratio is almost ...nstant (1·83 at 35 kv. and 1·96 at 80 kv.), with a ...obable error of 10-20 per cent. This is not sufficient, ...wever, to vitiate comparisons of line intensities as ...nctions of cathode ray energy. (2) *K*-electron ...nsation by direct impact of cathode rays. The ...obability of direct *K* ionisation in silver is 0·9 time ...e probability of an equivalent quantum emission ...the continuous spectrum at all voltages; direct ...isation is not usually an internal photoelectric ...fect.—**R. C. Gibbs** and **H. E. White**: Analysis of ...ectra arising from quadruply ionised tin, Sn V.—...ichard C. Tolman: (1) On the energy and entropy ...Einstein's closed universe. Using expressions ...eviously obtained which correspond to the first and ...cond laws of thermodynamics, and assuming that ...essure is not negligible compared with the energy ...nsity, an expression corresponding to entropy is ...tained. (2) On the equilibrium between radiation ...d matter in Einstein's closed universe.—**Oliver Wulf**: Photochemical ozonisation and its relation ...the polymerisation of oxygen. Earlier work, even ...ing back so far as the observations of Dewar and ...veing in 1889, but more particularly that of War...rg, G. N. Lewis, and Wulf, points to the existence of ...polymer of O_2 in *oxygen gas*; this molecule appears ...be O_4.—**Linus Pauling**: The shared-electron chemical ...nd. An extension of London's work showing that ...antisymmetric *eigenfunction* symmetric in the co...dinates of two electrons, which corresponds to a ...tential causing the two atoms to combine to form a ...olecule, can occur only if originally the spin of each ...ectron be not paired with that of another electron ...the same atom.

Official Publications Received.

BRITISH.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1130 (Ae. 300): A High Speed Wind Channel for Tests on Aerofoils. By T. E. Stanton. (T. 2562.) Pp. 9+6 plates. 9*d*. net. No. 1136 (Ae. 306): The Theory of Pressure Capsules. Part 1: General Discussion; Part 2: The Complete Flat Disc without Control Spring. By A. A. Griffith. (T. 2541 and A.) Pp. 14+1 plate. 9*d*. net. (London: H.M. Stationery Office.)

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 35: Kraft Pulp and Paper from *Pinus insignis*. By L. R. Benjamin, J. L. Somerville, R. B. Jeffreys and W. E. Cohen. Pp. 32. (Melbourne: H. J. Green.)

Empire Cotton Growing Corporation. Report on Cotton Breeding and Seed Supply in Nigeria. By F. L. Engledow and C. N. French. Pp. 32. (London.) 2*s*.

Joint Board of Research for Mental Diseases: City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1928. Pp. 15. (Birmingham.)

Colonial Survey Committee. Special Report on the Triangulations of Eastern and Central Africa, including Kenya, Northern Rhodesia, Nyasaland, Tanganyika Territory and Uganda. (Colonial No. 33.) Pp. 58. (London: H.M. Stationery Office.) 4*s*. 6*d*. net.

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum. Vol. 3, No. 4. Pp. 345-500. (Adelaide.) 10*s*. 6*d*.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1131 (Ae. 301): Lift and Torque of an Autogyro on the Ground. By H. Glauert. (T. 2502.) Pp. 4+1 plate. 4*d*. net. No. 1132 (Ae. 302): On the Vertical Ascent of a Helicopter. By H. Glauert. (T. 2546.) Pp. 14+3 plates. 9*d*. net. (London: H.M. Stationery Office.)

South Australia: Department of Mines. Mining Review for the Half-Year ended December 31st, 1927. (No. 47.) Pp. 72+7 plates. Geological Survey of South Australia, Bulletin No. 13: Pigment Minerals in South Australia. By R. Lockhart Jack. Pp. 70+5 plates. (Adelaide: Harrison Weir.)

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Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1927. Part 1. With Report of the Geological Survey Board and Report of the Director. Pp. iv+82. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Canada. Department of Mines: Mines Branch. Silica in Canada: its Occurrence, Exploitation and Uses. Part 2: Western Canada. By L. Heber Cole. (No. 686.) Pp. iii+59. (Ottawa: F. A. Acland.)

Journal of the Royal Microscopical Society. Series 3, Vol. 48, Part 2, June. Pp. xvi+120-255. (London.) 10*s*. net.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 39, Part 2, June 25th. Pp. 103-221. (London: Edward Stanford, Ltd.) 5*s*.

Journal of the Chemical Society: containing Papers communicated to the Society. June. Pp. iv+1401-1740+x. (London: Gurney and Jackson.)

International Geographical Union. First Report of the Commission on Pliocene and Pleistocene Terraces. Edited by Dr. K. S. Sandford. Pp. 123. (Oxford.)

FOREIGN.

Japanese Journal of Physics. Transactions and Abstracts, Vol. 4, No. 4. Pp. 159-184+77-105. (Tokyo: National Research Council of Japan.)

Meddelelser fra Kommissionen for Havundersøgelser. Serie Plankton, Bind 2, Nr. 2: Investigations on the Food of the Herring in Danish Waters. By P. Jespersen. Pp. 150. (København: C. A. Reitzels Forlag.)

Mémoires de l'Académie des Sciences et des Lettres de Danemark, Copenhague. Section des Sciences, 8me série, Tome 12, No. 1: The Hydromedusæ of the Danish Waters. By P. L. Kramp. Pp. 291. (København: Andr. Fred. Høst and Søn.)

Société de Propagande coloniale. Bulletin Nos. 3 à 6: Traité scientifique et industriel des plantes textiles. Les hibiscus (Ketmie): culture et exploitation. Pp. 160. (Paris.) 15 francs.

The Government of the Philippine Islands. Weather Bureau: Manila Central Observatory. Astronomical and Meteorological Conditions of the Eclipse of the Sun, May 9, 1929, in the Philippines. By the Rev. Miguel Selga. Pp. 24. (Manila: Bureau of Printing.)

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review (Supplement No. 30): Forest and Stream-Flow Experiment at Wagon Wheel Gap, Colo. Final Report, on Completion of the Second Phase of the Experiment. By C. G. Bates and A. J. Henry. (W.B. No. 946.) Pp. iv+79. (Washington, D.C.: Government Printing Office.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 178: The Principal Bulb Pests in Michigan. By Eugenia I. McDaniel. Pp. 23. Technical Bulletin No. 88: Investigations on Winter Wheats in Michigan. By E. E. Down, H. M. Brown, A. J. Patten, O. B. Winter and G. H. Coons. Pp. 35. (East Lansing, Mich.)

Reports of the Imperial Industrial Research Institute, Osaka, Japan. Vol. 7, No. 17: Dispersoidological Investigations, XII-XVI. By Prof. Dr. P. P. von Weimarn and Collaborators. Pp. 51+7 plates. 1.50 yen. Vol. 8, No. 6: Dispersoidological Investigations, XVII. By Prof. Dr. P. P. von Weimarn and Collaborators. Pp. 55+5 plates. 1.50 yen. Vol. 8, No. 13: Dispersoidological Investigations, XVIII-XXI. By Prof. Dr. P. P. von Weimarn and Collaborators. Pp. 80+10 plates. 2.20 yen. (Osaka and Tokyo: Koseikai Publishing Department.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 6: Diptera of the American Museum Congo Expedition. By C. H. Curran. Pp. 327-399. (New York City.)

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 11, 1927. Pp. 232+vi. (Rochester, N.Y.: Eastman Kodak Co.)

Annalen van de Sterrewacht te Leiden. Deel 13, Vierde Stuk: Catalogue of 460 Stars for the Epoch and Equinox 1885·0, from Meridian Observations made at Leiden in the Years 1880 to 1897. Pp. 47. Deel 16, Eerste Stuk: Discussion of Observations of Jupiter's Satellites made at Johannesburg in the Years 1908–1926. By D. Brouwer. Pp. 99. Deel 16, Tweede Stuk: Orbital Elements determining the Longitudes of Jupiter's Satellites, derived from Observations. By W. de Sitter. Pp. 94. (Leiden.)

CATALOGUES.

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. Pp. 130. (London: The British Drug Houses, Ltd.)

Bulletin des Publications nouvelles. 1er Trimestre 1928. Pp. 56. (Paris: Gauthier-Villars et Cie.)

Nickel Steel. Series A, Paper No. 1: Nickel and Nickel-Chromium Steels. Pp. 8. (London: The Bureau of Information on Nickel, Ltd.)

Diary of Societies.

SATURDAY, JULY 21.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Ilfracombe), at 12.

MONDAY, JULY 23.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory, Cambridge), at 4.30.—Dr. D. R. Hartree: The Wave Mechanics of an Atom with a Non-Coulomb Central Field. Part 3. Term Values and Intensities in Series in Optical Spectra.—E. B. Moullin: On the Period of Irregular Bars, with Special Reference to Ships.—W. H. McCrea: A Suggested Theory of Electric Conduction.—H. D. Ursell: Note on Pauli's Exclusion Principle.—S. L. Malurkar and J. Hargreaves: The Motion of a Particle in a Periodic Field of Force.—M. L. Oliphant: The Effects Produced by Positive Ion Bombardment of Solids: Metallic Ions.—*To be communicated by title only*:—J. E. Purvis: The Influence of Different Nuclei on the Absorption Spectra of Organic Compounds.—A. T. Starr: Slip in a Crystal and Rupture in a Solid due to Shear.—A. Dalcq: Les données expérimentales relatives au mécanisme de la division cellulaire.—Dr. A. S. Parkes: The Physiology of Ovarian Activity.—E. M. Delf: The Influence of Ultra-violet Light on Plants.—E. N. Willmer: Tissue Culture from the Standpoint of General Physiology.—W. K. Slater: Anaerobic Life in Animals.—F. E. Lloyd: The Contractile Vacuole.

CONFERENCES.

JULY 23-26.

BRITISH PHARMACEUTICAL CONFERENCE (at Cheltenham).

Monday, July 23.
Reception by the Mayor of Cheltenham.

Tuesday, July 24.
Welcome by the Mayor of Cheltenham.
Address by the Chairman of the Conference.
Science Meetings.
Delegates Meetings.

Wednesday, July 25.
Science Meetings.
Delegates Meeting.

Thursday, July 26.
Visit to Malvern.

JULY 24-27.

BRITISH MEDICAL ASSOCIATION (Annual Meeting, at Cardiff).

Provisional Programme.

Tuesday, July 24.
At 8 P.M.—Sir Ewen Maclean: Presidential Address.

Wednesday, July 25.
At 10 A.M.—Discussion: Diseases of the Coronary Arteries. Dr. G. A. Allan, Dr. A. G. Gibson, Dr. C. F. Coombs, Prof. G. Hadfield, Dr. C. B. Perry, Dr. I. J. Davies, Dr. D. E. Bedford, and Sir John Campbell.

Discussion: The Diagnosis and Treatment of Spinal Cord Tumours. D. J. Armour, Dr. G. Riddoch, Sir Percy Sargent, and G. Jefferson.

Discussion: Unsuccessful Forceps Cases. Prof. W. F. Shaw, Prof. J. Hendry, and Dr. D. A. Miller.—Paper: Prof. R. Vaudescal: Myomectomy during Pregnancy.

Discussion: Autotoxæmia as a Factor in the Causation of the Psychoses. Prof. W. Weygandt, Dr. E. Mapother, Dr. J. Porter-Phillips, Dr. Mary R. Barkas, Dr. A. Helen Boyle, Dr. D. F. Rambaut, Dr. F. A. Pickworth, and Dr. I. S. Wile.

Discussion: The Pathology of Encephalo-myelitis occurring in the course of Virus Disease and Exanthemata. Prof. H. M. Turnbull, Prof. J. McIntosh, Prof. J. C. G. Ledingham, Dr. M. H. Gordon, Dr. J. G. Greenfield, Dr. J. E. McCartney, Dr. S. P. Bedson, and Prof. G. Hadfield.

Discussion: Low Backache and Sciatica. W. A. Cochrane and P. J. Verrall.

Discussion: Chronic Splenomegaly in Childhood. Dr. R. Hutchison, L. E. Barrington-Ward, Dr. L. Findlay, and Dr. C. P. Lapage.

Discussion: Visual Efficiency and Working Ability. Dr. A. F. Fergus, Sir J. H. Parsons, and N. B. Harman.

Paper: Dr. T. H. Whittington: The Examination of the Eyes and Eyesight in Young Children.

Discussion: Chronic Ethmoiditis. Dr. R. Skillern and W. G. Howarth.

Papers: Dr. P. Watson-Williams: Case of Optic Neuritis due to Sphenoidal Sinusitis treated by Differential Exploration.—R. A. R. Wallace: The Ideal Treatment of Quinsy—Immediate Enucleation.

Discussion: The Relation between Trauma and Tuberculosis, especially from the point of view of Compensation and Accident Insurance. Dr. N. Tattersall, R. Milne, and Dr. O. May.

Papers on Factors in the Biochemistry of Tuberculosis: Dr. L. S. T. Burrell: The Therapeutic Value of the Heavy Metals.—Dr. J. C. Hoyle: The Serum Calcium in Experimental Tuberculosis.—Dr. W. H. Tytler: The Tuberculin-active Fraction of the Tubercle Bacillus.

Discussion: Ultra-violet Ray, and the General Public. Prof. W. E. Dixon and Dr. C. B. Heald.

Discussion: The Value of the Present Methods of Control of Infectious Diseases—(*a*) The Control of Small-pox. Dr. L. J. Rajchmann, Dr. J. M. Martin, Dr. T. E. Hill, Dr. R. P. Garrow, Dr. R. B. Low, and Dr. C. K. Millard. (*b*) The Control of Scarlet Fever and Diphtheria. Dr. R. A. O'Brien, Dr. J. G. Forbes, Dr. B. A. I. Peters, and Dr. E. H. R. Harries.

Discussions: (1) Recent Advances in Diagnosis and Treatment of Human Helminthiasis. Lieut.-Colonel Clayton Lane. (2) Transmission of Kala-azar. Dr. C. M. Wenyon.

Discussion: Historical Aspects of Ideas regarding the Nature and Treatment of Dropsy. Dr. J. D. Comrie.

Papers: Dr. E. R. Williams: Welsh Physicians and the Renaissance.—Dr. J. D. Rolleston: The History of Scarlet Fever.—Dr. P. Diverres: The Welsh Physician in the Middle Ages.—C. J. S. Thompson: The History and Lore of Cinchona Bark.

Discussion: Recent Advances in the Medical Treatment of Gastric Diseases. Dr. A. F. Hurst and Dr. T. I. Bennett: Treatment by Diet and Drugs.

Thursday, July 26.
At 10 A.M.—Discussion: The Prevention and Treatment of Diphtheria. Dr. J. D. Rolleston, Dr. J. G. Forbes, Dr. E. W. Goodall, and Dr. J. McGarrity.

Discussion: The Diagnosis and Treatment of Sterility. Dr. A. E. Giles, Dr. S. Forsdike, and K. M. Walker.

Discussion: The Differential Diagnosis and Treatment of Cerebral States consequent upon Head Injuries. Dr. C. P. Symonds, Dr. C. Worster-Drought, W. Trotter, Dr. R. D. Gillespie, Dr. D. McAlpine, and Dr. G. Riddoch.

Discussion: Variations in the Intestinal Flora in Health and Chronic Disease. Prof. J. Cruickshank, Sir Thomas Horder, Bt., Sir Thomas Houston, Prof. J. H. Dible, Dr. A. F. S. Sladden, Dr. L. P. Garrod, and Dr. C. E. Dukes.

Discussion: Volkmann's Ischæmic Contracture, with special reference to Treatment. Sir Robert Jones, Bt., S. Middleton, and A. H. Todd.

Discussion: Chronic Nephritis in Childhood. Dr. J. C. Spence, Dr. H. T. Ashby, and Dr. N. B. Capon.

Discussion: The Etiology of Glaucoma. W. S. Duke-Elder, T. Henderson, and N. B. Harman.

Paper: A. H. Levy: Telescopic Spectacles.

Discussion: Drainage of Brain Abscess. Sir Percy Sargent and S. R. Scott.

Paper: E. D. Davis: Injuries of the Ear arising from Fractures of the Skull.

Discussions: After-effects of Surgical Procedures on Cases of Pulmonary Tuberculosis. A. T. Edwards and Dr. F. G. Chandler. Tuberculosis as seen by the General Practitioner. Dr. R. Cameron and Dr. A. E. Kennedy.

Discussion: The Teaching of Hygiene. Dr W. W. Jameson and Dr. H. B. Brackenbury.

At 10 A.M. to 12 NOON.—Discussion: The Fallacy of X-rays in Abdominal Diagnosis. H. J. Paterson, Dr. F. Hernaman-Johnson, and Dr. A. F. Hurst.

At 12 NOON.—Discussion: The Treatment of Gangrene. W. S. Handley, P. Turner, and E. G. Slesinger.

Friday, July 27.
At 10 A.M.—Discussion: Acute Nephritis. Prof. T. G. Moorhead, Dr. H. L. Tidy, Dr. T. I. Bennett, Dr. H. Gainsborough, and Dr. R. L. McKenzie Wallace.

Discussion: Pancreatitis. J. W. G. Grant and Dr. A. F. Hurst.

Papers: Prof. W. W. Chipman: Acute Conditions in the Lower Abdomen of the Female.—E. Williams: The Acute Pelvis.—Dr. G. G. Ward: Radium Therapy in Carcinoma of the Cervix Uteri; an Analysis of the Results obtained at the Women's Hospital in New York.—Dr. E. F. Murray: Radium in the Treatment of Carcinoma Cervicis and Intractable Menorrhagia.—Dr. J. Young, Prognosis and Treatment of the Albuminuria of Pregnancy.

Discussion: The Early Treatment of the Psychoses and Psychoneuroses. Dr. A. Helen Boyle, Dr. E. Mapother, Dr. R. D. Gillespie, Dr. Mary R. Barkas, Dr. R. G. Gordon, Dr. J. R. Rees, and Dr. I. S. Wile.

Discussion: The Falling Birth Rate in its Various Aspects—(*a*) The Biological Aspect, Prof. F. A. E. Crew. (*b*) The Economic Aspect, Prof. W. J. Roberts. (*c*) The Medical Aspect, Sir Thomas Horder, Bt., and Lady Barrett.

Discussion: Urticaria. Dr. A. R. Hallam and Dr. H. W. Barber.

Papers: Dr. H. C. G. Semon: Souttar's Steam Cautery in Dermatology.—Dr. J. E. M. Wigley: Thallium Epilation in the Treatment of Ringworm.—Dr. W. J. O'Donovan: Salvarsan Ill-effects and Fatalities.

12 NOON.—Discussion: The Diagnosis of Ureteric Calculi. Prof. A. Fullerton, Dr. E. B. C. Mayrs, K. M. Walker, J. S. Joly, and H. Wade.

JULY 30–AUGUST 1.

INTERNATIONAL CONGRESS OF OTO-LARYNGOLOGY (at Copenhagen).

SATURDAY, JULY 28, 1928.

CONTENTS.

Contacts of Education and Industry.

THE Committee appointed by the President of the Board of Education and the Minister of Labour "to inquire into and advise upon the public system of education in relation to the requirements of trade and industry, with particular reference to the adequacy of the arrangements for enabling young persons to enter into and retain suitable employment," has now presented its second report,[1] which deals with the first part of the terms of reference. Already details of its recommendations have appeared in the press; and already certain criticisms of those recommendations, particularly with regard to their cautious framing, have been made.

It is not our purpose to attempt a defence against such criticisms. There can, indeed, be little doubt as to the cautious framing of the report. Its attitude towards the raising of the school leaving age, for example ("for the reasons given in the body of our report, we do not submit any recommendations . . ."), is doubtless disappointing when the weight of other opinion is considered. Its attitude, too, towards the development of full-time instruction in technical schools (which "must be considered with due regard to the factors of supply and demand") may not be very heartening. That the result of the growth of the internal system of examination is regarded as satisfactory; that "criticisms relating to basic subjects [taught in elementary schools] are too sweeping and are frequently made on insufficient ground"; that authoritative industrial opinion does not favour vocational training in primary schools; that the educational principles formulated by the Hadow Committee are accepted; that industry would benefit by a larger intake of pupils from secondary schools, and that to accomplish this the difficulty occasioned by the age of entry into apprenticeship, namely, sixteen years, "should be examined by the industries concerned"; that the grouped course system in evening schools is justifiable but should be more elastic; and that the system of advisory committees in connexion with technical schools "should as far as possible be made universal": all these points will be noted perhaps with a little impatience by those to whom the problems are familiar, and in their search for recommendations which shall show means of swift solution of these problems they may be apt to overlook not only the profounder

[1] Report of the Committee on Education and Industry (England and Wales). Second Part. Pp. 79. (London: H.M. Stationery Office, 1928.) 9d. net.

significances of this report, but also the fact that another committee, which has presented its report recently, has been dealing with the same terms of reference applied to Scotland.[2]

The two reports have been cast along similar lines, but the Scottish report seems bolder in its decisions. If the English committee hesitates concerning the school leaving age, the Scottish committee does not: in its first report it supported the raising of that age: in preparing this report the evidence "has confirmed us in the opinions therein expressed." Unlike the English report, too, it says clearly "attention should be given to the need for further development of whole-time technical education."

Probably the most disappointing feature of the English report is the fact that definite views were difficult to obtain from industrial sources. Yet both committees emphasise the need for employers to interest themselves in educational provision. The Scottish report puts it well:

> "It is not merely that they have an interest in seeing that the money they provide is intelligently spent. They depend for their success on the mental calibre of their workers. The employer takes every care to obtain good raw material and machinery that is economical and efficient; he should be equally careful to obtain workers who will be able to use their brains as well as their hands in the fashioning of the material and the tending of the machinery."

We would commend that passage to the National Confederation of Employers' Organisations, which appears to have found itself unable to give authoritative answers to any questions except those on the raising of the school leaving age and the establishment of compulsory day continuation schools—both of which it opposed.

In spite of the fact, however, that the Confederation was unable to submit its views to the test of examination by oral evidence, we would underline its view that "the absence of collective views on the part of employers is due largely to lack of knowledge of the system," and its hope "that some way may be found of increasing that knowledge and securing contact and practical co-operation." We quote these two statements because we agree with the committee that they "remove the suspicion that the employers of this country had already formulated a body of definite views and requirements which were being ignored by those responsible for education." We agree also with the Committee's view that, since educational nomenclature is a source of difficulty, the Board of Education should issue a short handbook descriptive of the educational system. Anything which will help employers to repair their lack of knowledge of the system and so enable them to contribute their views must be done speedily—particularly since the Committee has rightly insisted that "industries must define their needs, and no other body can do it for them." Not entirely unconnected with this is the indifference of employers to technical education, and the fact that its importance is missed also by many educationists.

Valuable as all this may be to clear the ground for the *rapprochement* between education and industry, it does not present what we have called the profounder significances of the reports. There are pointers in both to the wider and deeper aspects of the problems under review.

The employer is recommended to look on primary, secondary, continuation, and technical education not as four distinct types, but as mutually related elements in a coherent system. He is advised to do this immediately, because "unless there is a totally unforeseen reversal of educational ideals this conception of education above the age of 11 is likely to be put into practice within a generation." No employer ought to miss the point of that quotation, particularly the last phrase.

There is good reason, too, for the warning sounded concerning the urgency of a solution to these problems: "any special measures which can be taken to secure the contact which every one desires should be taken with all possible speed before the educational position becomes so solidified that any modifications, however desirable, will be extremely difficult if not impossible to make."

With such significant prophecy and warning before us, it becomes ever more urgent that we should not regard education and industry as two self-contained and separate matters which have in some way to be joined together. The reports do not fail, therefore, to indicate matters not always clearly visualised.

If criticisms are made concerning lack of discipline on the part of pupils now leaving school, the Scottish committee wisely points out that it is one of the faults not so much of the school as of lack of parental control during the War, and has been accentuated by subsequent years of trade depression and unrest. Poor housing conditions are also noted as a contributory factor. It thus becomes clear that a complete science of civilisation is necessary before ideals can be translated into

[2] Committee on Education and Industry in Scotland. Second Report. Pp. 40. (Edinburgh and London: H.M. Stationery Office, 1928.) 9*d*. net.

practice. The same may be said when complaints are made that pupils tend to want black-coated jobs rather than to enter industry. In this connexion we would refer our readers to NATURE of Nov. 12, 1927. In an article entitled "Technical Education and Industry" we summed up the views of educationists and industrialists given at the Leeds meeting of the British Association, and suggested that "if industry has correctly expressed its needs, and education can fulfil those needs, there ought not to be the slightest difficulty in placing every properly qualified student. That is surely an 'acid test' of the relationship between school and employment." We showed, however, that the present facts do not supply much evidence of that relationship, and, if firms find their administrative sides are more attractive to qualified students than their industrial sides, we asked:

"Is it not generally true that difference of status exists? Is it not generally true that in times of bad trade it is the production side which suffers, while the administrative side enjoys something very like permanence? Can the employers help to avoid this—a very real threat to the future skill and welfare of industry?"

We are glad to note, therefore, that both reports press the importance of this aspect of the problem.

"If the schools, to meet the wishes of industry," says the English report, "give some particular form to their product, industry must do its best to see that there are corresponding places to be filled, and filled beneficially, by recruits of this kind." ". . . the black-coated worker," says the Scottish report, "has a higher social status, better opportunities for advancement, and more chance of continuous employment, while usually his wages are in the long run higher than those of the average industrial worker."

There can be no doubt, too, that each report has placed a finger upon essential factors in the question of effecting contact between education and industry. The administrative structures of the two differ. Education "is organised primarily on the basis of local government areas. Industry . . . is organised mainly on a national basis . . . trade and commerce are for the most part organised on a local basis."

Clearly, therefore, to secure correlation there must be both local and national action. Both committees emphasise the value—indeed the necessity—of local inquiries, not so much for their immediate result on school curriculum and organisation, but for their effect of drawing employers and workers, teachers and administrators together to get to know each other personally and to appreciate each other's point of view.

Both committees also see that such local inquiries must be supplemented by national action, and they therefore make what we regard as their most important recommendation, namely, that a small national committee, representative of the views of employers, workers, local education authorities, and teachers, should be established by the Board of Education (in the case of Scotland by the Scottish Education Department) to undertake the necessary national negotiations. Briefly, the function of that committee would be to inform trade and industry of the educational system, to assist trade and industry in the formulation of their views, and to consider with education authorities how far those views can be met. It may be remembered that the machinery of the Emmott Committee (cf. NATURE, Jan. 14, 1928) has already made such a committee possible.

We have said that the reports have profounder significances than may be realised at first sight, even though some of their recommendations may not appear to give clear and final answers to the problem faced. But it is better, we think, to formulate those problems so that they may be seen in relation to modern development, and so that their urgency becomes apparent, than to propose piecemeal legislation which touches but lightly root causes and tendencies. For this reason we congratulate both committees on their attitude. In doing so, however, we must not fail to emphasise the fact that neither report may be regarded as self-sufficient even in the formulation of the problems. Both must be read in conjunction with the reports of other committees which have dealt with the other angles of those very problems. We would therefore refer our readers, in addition to those of our issues to which we have already referred, to NATURE of April 9, 1927, p. 517; Feb. 5, 1927, p. 185; and Jan. 8, 1927, p. 69, where these earlier reports have been discussed.

Finally, since there are not lacking those who think the educational problems involved can be solved by the mere addition of so-called 'practical' subjects to a so-called 'liberal' curriculum, we would suggest that the following extract from the English report is evidence that the Committee has grasped an important point in educational philosophy which is often missed, particularly by educationists: "Special subjects should not merely be added to the curriculum, but should be correlated and interwoven with the other subjects of the curriculum."

Common Sense in Engineering and Philanthropy.

Alfred Yarrow: his Life and Work. Compiled by Lady Yarrow. Popular Edition. Pp. xii + 276 + 78 plates. (London: E. Arnold and Co., 1928.) 5*s.* net.

THIS book of nearly 300 pages and nearly 100 plates details very fully the life and work of a remarkable man, who, though active and useful at the present day, is eighty-six years of age. Reading it conveys the impression that Sir Alfred Yarrow is not so much a remarkably clever man, as one who is guided in his actions entirely by common sense. Perhaps he showed this very early in life when he declined to take interest in languages, having neither voice nor ear for music, but made great progress in realistic studies, such as physics and mathematics. He showed the same spirit in his pranks when he pumped air into a gas main and put the lights out, and when he caused the cook with a tray of glass to get an electric shock from an electrically charged plate, causing her to drop and smash all the glass.

Sir Alfred Yarrow began life as a marine engineer at Ravenhill's on the Thames. While he took interest in many other things, he has remained a marine engineer throughout his life. In 1857 he rigged up a private telegraph with one of his friends, and this is believed to be the first private telegraph in England. When between eighteen and twenty years of age, he invented and patented a steam plough, which was made by a firm of engineers to whom he became the agent for the sale, and in that capacity he made enough money to get started in business as a boat-builder. In 1868 he commenced building high-speed steam launches, and up to the year 1875 he had built 350 of these. Between that date and 1880 he built torpedo boats obtaining a speed of 20½ knots. In 1878 the first vessel of this type performed a sea voyage successfully with Sir Alfred Yarrow and his wife on board. In 1880 a Russian torpedo boat built by Sir Alfred Yarrow attained a speed of 22 knots, and steamed to the Black Sea.

Up to this time, all torpedo boats had been fitted with compound engines, but in 1885, Sir Alfred made a triple-expansion engine which gave an increased speed. In 1887 the first water-tube boiler made by his firm was fitted (in a second class torpedo boat). In 1892 he made an aluminium vessel for the French, but neglect on the part of her owners to protect the aluminium discredited the use of this metal for a considerable time. Up to this time locomotive boilers only had been used in the fast small ships, but in the year 1892, Yarrow built two vessels, the *Havock* and *Hornet*, the second of which had water-tube boilers, the adoption of which increased the speed to 27·3 knots. In 1894 the so-called destroyer *Sokol* was the first vessel to obtain a speed of 30 knots. High tensile steel was first used in the construction of this vessel, and she was fitted with eight water-tube boilers. In 1896 the Dutch Government fitted a cruiser with Yarrow boilers of 7000 h.p. and Scotch boilers of 2250 h.p. History is repeating itself, as some of the latest Atlantic liners have similar combinations. In 1899, Sir Alfred Yarrow built destroyers for the Japanese government of 6000 h.p. and obtained a speed of 31¼ knots. In 1905 the first double-ended water-tube boiler made by his firm was fitted, and by 1910 the double-ended boilers were capable of developing 4500 h.p. each.

There is not much said in this book about the introduction of oil, but this undoubtedly had a great effect on the design and power produced by the Yarrow boilers. In 1911 superheat was introduced, showing a gain of 10 per cent at full speed, and 15 per cent at low speed. The *Lurcher* class of the British Navy attained a speed of 35 knots at this time. Since then the development of the destroyer has not been very great. Larger sizes, and consequent increases in speed and radius of action, have followed. The destroyer as it now exists is very largely the work of Sir Alfred Yarrow, though others, including Thornycroft and Normand, have contributed their share.

Other types of vessels difficult to design have been developed by Sir Alfred Yarrow for the Congo and the Nile and other parts of the world. These vessels have been sometimes for peace and sometimes for war. They were very light draft vessels, having sometimes stern wheels and sometimes screws with hinged flaps at their stern. Vessels of 120 ft. long, drawing 12 in. of water, and some even less than that, were built. Some had to be carried hundreds of miles by natives through forests, no part carried being more than 50 lb. in weight. The vessel was put together at the end of the long journey to the water of the lake for which she was intended.

So far, we have referred to the work of Sir Alfred Yarrow as an engineer. Many improvements which he introduced are simple and common sense but extremely useful. His work has been a steady development on safe lines, but has always proved useful.

The other parts of the book are connected with

Sir Alfred's work as an employer and his relations with the workmen, which seem also to have been guided by common sense, treating the workmen as comrades in engineering and as entitled to their proper share of the moneys received for the work.

Sir Alfred Yarrow's philanthropy has become so well known that it seems scarcely necessary to record his many gifts to the nation. Beginning with the last, we have a gift of £10,000 to the British Association, and £30,000 and £100,000 to the Royal Society. A gift of £20,000 was made during the War, to be distributed in amounts not exceeding £1000 for the capture or destruction of any enemy submarine or ship of war. As this fund was not all used up, the balance was devoted towards the Royal Merchant Seamen's Orphanage at Bearwood. He also offered a reward of £20 up to a total expenditure of £10,000 to anyone on board a merchant vessel who first sighted an enemy submarine.

This book is extremely interesting, both from the point of view of the life of a very useful man, and from the point of view of the history of a great deal of the high-class shipbuilding of the last fifty years. We have to thank Lady Yarrow for revealing so many interesting facts in such a very readable manner.

Lubrication and Lubricants.

Lubrication and Lubricants: a Treatise on the Theory and Practice of Lubrication, and on the Nature, Properties, and Testing of Lubricants. By Leonard Archbutt and R. Mountford Deeley. Fifth edition, revised throughout, greatly enlarged, reset. Pp. xxxii + 650. (London: Charles Griffin and Co., Ltd., 1927.) 36*s.* net.

THIS treatise is in all probability the most complete that has hitherto been published in the English language. The work is thoroughly comprehensive. The general lay-out is admirable; the opening chapter is a brief dissertation entitled "The Problem of Lubrication," and may be regarded in the light of an introduction. The problem is here epitomised in three pages of printed matter, and the ability with which the essentials of the subject have been dealt with in this limited space is masterly. The reader is left with a clear conception of the trend of modern thought and the complexity which recent investigations have introduced into a subject once regarded as comparatively simple.

In view of the fact that recent work has shown the importance of the study of thin films and surface forces, it is not surprising to find some twenty-five pages devoted to the discussion of this field of investigation. Chapter v. deals with the theory of viscous lubrication. This section includes a reference to the Michell thrust bearing. While it is difficult to point to any omissions, one cannot help feeling that more space might have been devoted to this branch of the subject.

The next section (Chapters vi.-ix. inclusive) deals with the sources, preparation, and general properties, also the physical and chemical properties of lubricants, and includes methods of examination and testing. This section, which constitutes about half the volume of the book, is in itself a very thorough treatise for those interested in the laboratory aspect of the subject.

We next have what may be legitimately regarded as the engineer's section of the book, dealing with the frictional testing of lubrication, appliances for lubrication, and the design of lubricated bearings. All this work is commendable, but in view of the fact that there is literally no end to the subject, it can only be considered a bare outline. A short chapter included in this section on the design and lubrication of ball and roller bearings is welcome, in view of the fact that the rôle or part played by lubrication in roller and ball bearings is too easily forgotten.

Chapter xiv., dealing with lubrication of engines and machines, again can be scarcely regarded as exhaustive. This chapter alone could be well expanded into a whole volume if the authors had been writing an encyclopædia instead of a book. The concluding chapters dealing with the clarification and recovery of used oil and the management of machinery are no more than résumés. This is no fault of the authors, in view of the limited space.

It is curious to note in a work so thorough that no mention appears to be made of the synthetic lubricant known commercially as "Halowax" (chemically, monochlornaphthalene). While it is true that this has but little present importance, save as an ingredient added to a certain brand of petrol to lubricate valve stems in internal combustion engines, the omission is remarkable on account of the fact that it is a lubricant which is unique in many respects and one with regard to which information is difficult to obtain.

Lastly, the index, though by no means perfect (who has ever achieved perfection in this respect!), is well above the average.

The New Reformation.

The New Reformation : from Physical to Spiritual Realities. By Michael Pupin. Pp. xvii + 273 + 8 plates. (London and New York : Charles Scribner's Sons, Ltd., 1927.) 8*s*. 6*d*. net.

MICHAEL PUPIN is a romantic figure in the world of science. He has told us the story of his life in his autobiography, "From Immigrant to Inventor" (reviewed in NATURE of Feb. 9, 1924), a pilgrimage on the stony path trodden by those 'saints of science'—Galileo, Newton, Lagrange, Faraday, Clerk Maxwell, Helmholtz—for whose lives he expresses unbounded praise and thanksgiving. A Serbian immigrant, Pupin landed in the United States with only five cents in his pocket, and these he promptly spent in the purchase of a piece of prune pie. The prune pie proved to be a "bogus prune pie." But the young immigrant felt no resentment against his adopted country for the loss of his initial capital. He has, indeed, become one of its most redoubtable champions. The trouble about America appears to be that it is equally easy to prove its idealism or its materialism. On that issue, Pupin is on the side of the angels ; but, by a happy chance, he has greatly increased the capital wealth of the United States. The money value of his inventions in long-distance telephony alone has been estimated at one hundred million dollars. Some years ago the National Institute of Social Science presented him with a gold medal "almost as big as the full moon": he appreciated more the proud title of "public benefactor" accorded to him on that occasion.

In search of an answer to the question "What is light ?" the ingenuous youth arrived at Trinity College, Cambridge, and asked for Clerk Maxwell, only to learn that Clerk Maxwell had died four years before. There Pupin studied for a year or so, under the mathematical giants of those days—Routh, Rayleigh, Adams, and Stokes. But the traditional Cambridge policy did *not* suit him, his inclinations being towards physics. Many other Cambridge men, he tells us, failed to find in tripos drills the stimulating elements of that scientific spirit which leads to original research.

At this time, Tyndall, having given some scientific lectures in the United States, decided "to devote every cent of the money which you have so generously poured in upon me to the education of young American philosophers in Germany." Science was in a bad way in the old country. A correspondent in NATURE suggested that science was "all but dead in England," and "deadest of all at our Universities"—by science meaning "that searching for new knowledge which is its own reward." An enormous examining machine, on the most approved Chinese model, our correspondent said, was always at work, but . . .

Pupin took advantage of Tyndall's benefaction to study under Helmholtz at Berlin. Soon after his arrival, Helmholtz assured him that "a few scientific experiments successfully carried out usually lead to results more important than all mathematical theories"—a dictum which, curiously, has been amply confirmed at Cambridge in the Cavendish Laboratory, opened in 1874. After a long course at Berlin he obtained his doctor's degree. Matrimony, and an appointment at Columbia University, New York, followed, and he now looks back—if such a forward-looking man can look back—on a record of notable achievement both in scientific discovery and in the promotion of scientific research.

To this record Pupin has now added, by the publication of "The New Reformation," a scholarly contribution to the philosophy of science. The preliminary chapters on the history of science are excellently written, placing well-known facts in a new and interesting setting. Whatever Nature may do, science appears to progress *per saltum*. We jump from Archimedes, a space of fifteen hundred years, to that golden age,

"which listened to Martin Luther ; listened also to Shakespeare, Gilbert, and Francis Bacon ; was thrilled by the matchless art of Hals, Holbein, Leonardo da Vinci, Raphael, and Michelangelo ; wondered at the astronomical achievements of Copernicus, Tycho Brahe, and Kepler ; watched in spellbound admiration the first flashes of the flame of Galileo's genius."

"Spellbound admiration" of Galileo's genius is picturesque, and we hope it may be true. It was not shared by the Inquisition which confined Galileo as a prisoner in his own house. It is a shock to learn that Newton was born in the year in which Galileo died—Newton, who ran no risk of theological persecution, whose tomb in Westminster Abbey proclaims "he was the glory of mankind," whose contemporary, Halley, the astronomer, said, "It will never be permitted any mortal to approach nearer to Deity."

So the story unfolds itself. We feel we are approaching towards an answer to the question, "What is light ?"—through Faraday, Davy's greatest discovery, to Clerk Maxwell, who wrote to a friend :

"I have a paper afloat, with an electro-magnetic theory of light, which, till I am convinced to the contrary, I hold to be great guns."

"What is Light?" Has an answer been given? If so, we may pass on to the even more difficult question, "What is Life?" In "The New Reformation" Pupin has attempted to find "a short and easy journey" from the physical realities of the inorganic world to those of the organic world, and to the world of our consciousness—the master problem which philosophers in all ages have endeavoured to solve. Order replaces chaos. Physical operations, governed by definite laws, show an orderly advance from lower to higher forms, and this applies equally to the organic and to the inorganic world. But what process of "creative co-ordination" interprets to our consciousness "the perfume of the rose, the comforting glow of the log in our fireplace, the ambrosial sweetness of the honey"? Electrical flux, an ultra-material substance, has become "a dynamically definite and hence perfectly intelligible physical entity" because the laws of its actions and reactions have been formulated in terms of Newtonian dynamics, verified by electrical radiation experiments.

Can we hope to understand in the same way the spiritual world? Pupin replies boldly that Christ's dynamics govern the spiritual world; love is the co-ordinating force, the counterpart of gravitation in the physical world; science and religion must supplement each other. "If the signs of the time do not deceive me, then there is a universal drift towards this mental attitude. This drift I call 'The New Reformation.'" T. LL. H.

Europeans in Abyssinia.

Seven Years in Southern Abyssinia. By Arnold Weinholt Hodson. Edited by C. Leonard Leese. Pp. xvi + 267 + 24 plates. (London: T. Fisher Unwin, Ltd. (Ernest Benn, Ltd.), 1927.) 18s. net.

CAPTAIN HODSON was sent in 1914 to establish the first British Consulate in Southern Abyssinia, his immediate purpose being to safeguard the timid Boran tribes and the elephants of Kenya Colony against further raids across the border. His appointment was agreed to with some reluctance on the part of the Ethiopian government, partly because it was a reflection on that government's capacity to control the acts of its own peoples, but largely because of the ingrained and not altogether unfounded suspicion that all such appointments are symptomatic of the desire of Europeans to increase their influence in the last and only indigenous independent State in Africa. To add to Capt. Hodson's difficulties, he increased suspicion of his motives by having to enter Abyssinia from the south—the railway from Jubito to Addis Ababa was not then constructed—as there is a legend among the peoples of Abyssinia that it is from the south that the white man will eventually overrun their country. The fact that it took the author nearly six years to establish his consulate, although the ruler at Addis Ababa ostensibly favoured the project from the outset, is not a reflection upon his courage, negotiating skill, or determination, but an indication of the state of chaos of the country and the contempt for Europeans which existed.

The volume is interesting from a political rather than a scientific point of view. It adds very little to our existing knowledge of the peoples, their origins, beliefs, customs, and occupations. Such matters are dealt with rather sketchily. There is the same lack of precision regarding geographical facts; for example, the sketch map provided of Southern Abyssinia, illustrating the routes followed by the author in his various journeys through the country, is very inadequate. A large-scale map showing, even roughly, the main physical features of the district would have lent interest to the text. Again, Capt. Hodson mentions that of the eight lakes in the chain from Rudolf to Zwai, four are salt- and four are fresh-water, some are infested with crocodiles, some are not. Why? he asks. We cannot say, but had he possessed more curiosity he might have supplied the answer. He informs us that some tribes dwelling near lake-shores do not eat the edible fish of the lakes and tributary streams, but he offers no explanation, though it would be of the greatest interest to know why these tribes differ so markedly in this respect from, say, the fish-loving Baganda or Kavirondo in the Victoria Nyanza region.

Nevertheless, this book will make an immediate appeal to all those interested in this little-explored part of Africa. The account given of the state of chaos and anarchy which prevailed at any distance from the capital up to the time the author left for the south-western district, of the difficulties which he encountered, and the irksome and thankless duties performed by the British military forces at Moyale—just across the border—of the inhumanity of the slave-making 'Christian' dominant race, and the prodigal waste of the country's wonderful natural resources, almost justifies the intervention of the European powers, or at least that of the League of Nations. It should provide much food for reflection for those chronic sentimentalists at home who see nought but evil in the impact of Europe on Abyssinia. A. G. C.

Our Bookshelf.

The Theory of Functions of a Real Variable and the Theory of Fourier's Series. By Prof. E. W. Hobson. Vol. 1. Third edition, revised throughout and enlarged. Pp. xv + 736. (Cambridge: At the University Press, 1927.) 45*s*. net.

THE theory of functions of a real variable is a subject of fairly recent date and is necessarily expanding as new theorems are discovered and fresh generalisations effected. On the other hand, the refinements of modern investigations make an ever-increasing demand for rigorous examination of their mathematical groundwork. For this reason the mathematical physicist cannot afford to remain ignorant of the progress of function theory. Prof. Hobson has an admirable gift of lucid exposition of the subject of which he is a master, and the reader can follow him with delight into realms which may occasionally appear to belong to philosophy rather than to mathematics.

The second edition of vol. 1 appeared in 1921. The present, third edition, is a revision of the second. Much new matter has been added, thus extending the volume by 65 pages. Corrections and additions given at the end of vol. 2, which was published in 1926, have been incorporated, but the numeration of the sections has wisely been retained. The first four chapters develop the properties of numbers and sets of points. Chap. iv. in particular gives an exposition of transfinite numbers and order types, developed as an ordered body of doctrine and followed by a critical discussion of the validity of the theory. In those theorems the proof of which is based on the much-debated multiplicative axiom, the fact of its use has been pointed out. Chap. v. is devoted to the consideration of functions in general, their continuity, discontinuity, and differentiation.

The remaining three chapters are concerned with the theory of integration, which naturally begins with the Riemann integral. Prof. Hobson considers this as of great intrinsic importance in analysis, and the basis on which practical applications of the integral calculus will continue to rest. The sections dealing with the Riemann-Stieltjes integral have been rewritten. A discussion of the Lebesgue integral, which now holds first place in theoretical investigations, follows. A considerable part of the theory of integration in relation to series is to be found in vol. 2. The present volume concludes with a chapter on non-absolutely convergent integrals. The printing is of course excellent, and the price for a work of this importance is not excessive.

Hermes: or The Future of Chemistry. By T. W. Jones. (To-day and To-morrow series.) Pp. 88. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2*s*. 6*d* net.

FEW topics appeal so much to our instinct of wonder as what the future may have in store. Whether the predictions are made by "Old Moore" or by the sober student of science, they invariably attract, and the more daring the prophet the greater the attraction. The author of this essay is certainly to be classed among the more sober of the prophets; he is cautious to a degree; he bases his predictions on present tendencies, and as a rule does not venture more than a few paces into the unknown. Thus, he is sure that low-temperature carbonisation has come to stay, and that liquid fuels will be manufactured on a large scale from coal and by synthesis from such materials as hydrogen and carbon monoxide. Supplies of timber will become exhausted; buildings will be made mainly of metal, and building costs will fall when roofs and other parts are made by the casting of plastic cement. Cotton will maintain its ascendancy as the chief raw material of clothing, and nitro-cellulose lacquers will greatly reduce the consumption of paints. The author does not believe in the future of synthetic foods, at least of those that might be made from coal-tar products; but he appears to have overlooked the possibilities of 'mineral yeast,' which was made in Germany during the War, and is now attracting attention in Great Britain. Not long ago a president of the American Chemical Society said that within a century or two we should be able to supply the food demands of the world through micro-organisms working on mineral products!

Although the essay is well written and suggestive, there are a few deviations from the straight path of scientific accuracy. Chilean nitrate does not at present meet one-third of the world's needs for nitrogenous fertilisers, but 24 per cent (in 1926), the quantity of atmospheric nitrogen converted into fertilisers in 1926 was 970,250, and not 1,245,000 tons (the latter total includes Chilean nitrate), and no one familiar with the subject could have expected at least half as much again to be fixed in 1927. The most trustworthy estimate for 1927 is 1,179,000 metric tons. The assertion that the application of chemical science to matter is the *only* efficient method of controlling it for the needs of mankind will scarcely commend itself to the devotees of other branches of science.

Structural Engineering: Stresses, Graphical Statics, and Masonry. By Prof. G. F. Swain. Pp. x + 525. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 25*s*. net.

AMERICAN authors have been very active of late years in the production of comprehensive treatises on various aspects of structural theory and design. Prof. Swain, who is professor of civil engineering in Harvard University, is a leading exponent of this subject, and the present volume is the third in his ambitiously planned series of five on structural engineering. The previous two volumes dealt mainly with materials, but this third concentrates on the theories of statically determinate framed structures, of earth pressure, and of masonry structures.

The whole range of what is usually designated graphical statics is developed in very complete fashion; and the analytical methods of treatment for all problems involved in the discussion of frames

are clearly presented. A sketch is given of the development of structural forms and an interesting short chapter on the economics of simple trusses is included. The subject of impact is concisely discussed, but the details are mainly confined to the usual ideas and allowances, and no reference is made to the recent theoretical work of Prof. Inglis of Cambridge on this question. The treatment of earth-pressure theories is very adequate, and the author's critical development of the various principles and methods in this difficult subject is of special value. The chapters on masonry structures include studies of retaining walls, piers, dams, and stone arches, and present all the main principles free from the misleading profoundity that occasionally characterises treatments of this subject.

Throughout the entire work, the author's grasp of method is well displayed, and many of his short chapters are models of concise presentation. He is mainly concerned with principles, and his development of and critical attitude towards these endow the book with a high educational value.

Beyond the Electron: a Lecture given at Girton College on March 3, 1928. By Sir J. J. Thomson. Pp. 44. (Cambridge: At the University Press, 1928.) 2*s.* 6*d.* net.

ALL who are interested in the discoveries of modern 'ysics as to the intimate structure of the universe ll be grateful to the authorities of Girton College r persuading Sir J. J. Thomson to deliver, and to e Cambridge University Press for publishing, is lecture. In the art of making the deep things physics plain, not merely to the professional ientific worker but also to the educated world large, Sir J. J. Thomson has few equals. It es not seem so very long since he was leading beyond the atom into a new world of electrons. him, however, "each discovery is not a terminus t an avenue leading to country as yet unexored," and he now invites us to accompany him a region still more remote and even more scinating, "Beyond the Electron."

invasion of this new domain has been made ssible by the discovery, due to Davisson and unsmann and to Prof. G. P. Thomson, that in rtain circumstances the electron can be diffracted exactly the same way as light: a discovery hich may be regarded as complementary to the ow established fact that light under certain nditions can behave like a particle. In this cture Sir J. J. Thomson deals with these new scoveries in his usual masterly manner, and raws for us a picture, as clear as it is interest- of the way in which this twofold connexion etween light and energy may arise. It is true at the phenomena can be dealt with by a method f analysis of de Broglie and Schrödinger. Those of however, who demand from research a picture the universe rather than a set of mathematical uations, will be very grateful to Sir J. J. Thomson the fascinating picture he has outlined so early in these delightful pages. We may add at those who desire a more formal exposition of the eory will find it in two mathematical appendices.

Electric Winders: a Manual on the Design, Construction, Application, and Operation of Winding Engines and Mine Hoists. By H. H. Broughton. Pp. 402. (London: Ernest Benn, Ltd., 1927.) 52*s.* 6*d.* net.

THE whole development of electric winding in mines has taken place within the comparatively short period of twenty years. The method has proved itself thoroughly trustworthy, and in many respects superior to the older steam-engine types. The ease with which automatic devices in aid of control may be incorporated in the equipment is a special advantage, and completely automatic installations have been designed in which even an operator is unnecessary.

In the present elaborate treatise on this subject, Mr. Broughton presents a vast range of valuable data on equipments of all types, designed for a wide variety of duties, which he examines and discusses with great care and thoroughness. Both the mechanical and electrical sides of the system are exhaustively treated, and all questions of type, performance and cost are systematically studied. The book is not exactly a text-book on design, but it contains that essential and accurate information which the designer must not ignore. It is at once a treatise and a book of reference, and should prove invaluable to the engineering student, to the designer and manufacturer, and to mining engineering staffs.

Untersuchungen zur Quantentheorie. Von Louis de Broglie. Übersetzt von Dr. Walther Becker. Pp. ii + 88. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1927.) 5·80 gold marks.

IT is sufficient evidence of the importance of M. de Broglie's memoir that the three years of rapid advance in quantum theory that have elapsed since it first appeared, still allow it to be republished in the form of a direct translation into the German. Not the least recognition that can be made of the author's fundamental contributions to the subject is that very recent work tempts us to query his statement in the preface (September 1927) that "la constitution d'une théorie ondulatoire de la matière dans le cadre de la physique du champ . . ." seemed remote: his own comments upon the work of Schrödinger and of Heisenberg are most generous.

Through Jade Gate and Central Asia: an Account of Journeys in Kansu, Turkestan, and the Gobi Desert. By Mildred Cable and Francesca French. Pp. xvi + 304 + 12 plates. (London: Constable and Co., Ltd., 1927.) 10*s.* net.

THIS is an account of a journey made by three members of the China Inland Mission who started from China and worked their way through Mongolia and Chinese Turkestan to Siberia. The prospects of such a journey would appal most men; the missionaries who made it were women. The difficulties, hardships, and dangers that were faced and overcome are not emphasised, but those who know the route they travelled will best appreciate the courage and endurance of the three ladies who write so modestly of their achievement.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Nierenstein Reaction.

BEFORE commenting on the issues of scientific interest raised in the letter (NATURE, June 16, p. 940) entitled "The Nierenstein Reaction," we would point out that it is not suggested that the results of Nierenstein and his co-workers *cannot* be corroborated. Up to the present time, however, we have failed to corroborate them in the course of numerous attempted repetitions of various examples; moreover, we do not find that Arndt's recent work confirms that of Nierenstein in this field.

In reply to the last paragraph of Dr. Nierenstein's letter, we must point out that he incorrectly states that we described the supposed crystallisation of diphenyldibromodioxan from alcohol as an unconventionality; the actual sentence was: "The chemistry involved in the degradation of the latter substance (diphenyldibromodioxan) is of an unconventional type." The reference was mainly to the hydrolytic fission of an ether by aqueous alkali under mild conditions, and we think that an interpretation requiring such an assumption can be justly criticised. Our interest in the crystallisation of diphenyldibromodioxan was confined to the evidence of stability of the substance in alcoholic solution (which was implied by the preparation of a picrate in this medium); actually it was the analogous di-(triphenylmethyl)-dichlorodioxan that was crystallised from alcohol. Thus our admitted slip in transcribing an abstract of the paper by Lewis, Nierenstein, and Rich did not in any way distort the theoretical aspect.

Turning now to the main question and taking benzoyl chloride as an example to facilitate discussion, Nierenstein considers that the reaction in question takes place in accordance with the equation (*a*), whilst we contend that the process is represented by (*b*), followed by (*c*) and (*d*).

$$PhCO\,.\,Cl + CH_2N_2 = PhCO\,.\,CH_2Cl + N_2 \qquad (a)$$
$$PhCO\,.\,Cl + CH_2N_2 = PhCO\,.\,CHN_2 + HCl \qquad (b)$$
$$HCl + CH_2N_2 = CH_3Cl + N_2 \qquad (c)$$
$$PhCO\,.\,CHN_2 + HCl = PhCO\,.\,CH_2Cl + N_2 \qquad (d)$$
$$PhCOCl + 2CH_2N_2 = PhCO\,.\,CHN_2 + CH_3Cl + N_2 \qquad (e)$$

It was observed in separate experiments that the reaction (*c*) occurred much more rapidly than (*d*), and therefore when benzoyl chloride is added to diazomethane the process is represented by (*b*) and (*c*) until all the diazomethane is used up. The equation (*e*) thus expresses the net result when the chloride is gradually added to the diazomethane, whatever the relative proportions of the reagents. Equation (*e*) also represents the process when two or more molecular proportions of diazomethane are brought into reaction with one molecular proportion of the chloride under any conditions. That is to say, with an excess of diazomethane, it makes little difference whether the chloride is added to the diazomethane or the diazomethane to the chloride, and the product will be the diazo-ketone. Nierenstein has, however, prescribed the use of an excess of diazomethane for the preparation of several chloromethyl ketones.

The most interesting case arises when diazomethane (1 mol.) is gradually added to a solution of benzoyl chloride (1 mol.). Experiments along these lines have been conducted, using as the solvent anhydrous ether and also ether dried over calcium chloride; the results were substantially the same in the two cases. The diazomethane was very rapidly attacked, and examination of the products after keeping for one hour after the cessation of the visible evolution of nitrogen showed that they consisted chiefly of diazoacetophenone and a little unchanged benzoyl chloride together with a very small proportion of chloracetophenone. This proves that (*a*) is not the primary action and that (*b*) and (*c*) are much more rapid than (*d*). The amount of unchanged benzoyl chloride was, however, less than half that originally used, and therefore the total result is summarised not by (*e*) alone, but by (*e*) and (*b*) in a certain relation determined by the conditions. Clearly, (*b*) will be followed in the course of time by the slow reaction (*d*), and thus the yield of chloracetophenone will be the higher the more effectively benzoyl chloride can compete with hydrogen chloride for the diazomethane that enters the system and also the longer the time, up to a limit, allowed for the completion of the reaction. In the early stages of the addition of diazomethane (1 mol.) to benzoyl chloride (1 mol.) the ratio of the concentration of the acid chloride to that of hydrogen chloride is large and the only important reaction is (*b*); as the addition proceeds the concentration of hydrogen chloride increases and that of the acid chloride diminishes, and since (*c*) can be shown independently to be a very facile and rapid reaction, it occurs to a greater and greater extent in the course of the process of admixture.

The observed immediate evolution of nitrogen is a measure, then, not of the formation of chloracetophenone in accordance with (*a*), but of the extent to which the final yield of chloracetophenone by (*b*) and (*d*) falls short of the theoretical.

Under favourable conditions we have found that the yield of chloracetophenone, ultimately obtainable from benzoyl chloride (1 mol.) and diazomethane (1 mol.) by slowly adding the latter to the former, and allowing more than twelve hours for the completion of the second phase (*d*), does not exceed 9 per cent of that theoretically possible; this was estimated by analytical methods and represents a maximum for this procedure. On the theoretical basis outlined above we anticipate that, using equimolecular proportions, the optimum conditions, (i) for the production of a high yield of diazoacetophenone if the product is worked up after a short time, and (ii) for the production of chloracetophenone if the mixture is kept for many hours, should be reached when the reagents are mixed as rapidly as possible. This gives the best chance for (*b*) to proceed to completion before (*c*) can supervene and cause loss.

When diazomethane (1 mol.) was added to an ethereal solution of benzoyl chloride (2 mol.) it was found that one-half of the benzoyl chloride was unacted upon; evidently the main reaction was (*b*). Even in this case, however, the product isolated after keeping overnight was a mixture of chloracetophenone and diazoacetophenone.

We are in agreement with the view expressed by Arndt that the course taken by the reaction may depend on the constitution of the acid chloride; this applies particularly to conditions under which reactions of the type (*d*) assume an important rôle. Thus we know that aliphatic diazo-ketones are more readily decomposed by acids than are the diazoacetophenones, and, on the other hand, the diazonitro-acetophenones are particularly stable.

The experiments on which the above analysis is

based have been performed in collaboration with Dr. G. Schwarzenbach. The details will, it is hoped, be included in a subsequent publication.

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Adjustable Needle Valve Leaks.

A SATISFACTORY adjustable needle valve for admitting a small constant flow of gas into a highly exhausted vessel is difficult to make. A number of ingenious forms have been described by various workers.[1] The valve should close tightly, open

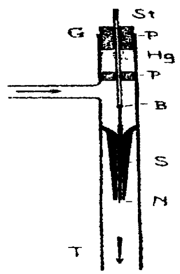

FIG. 1.

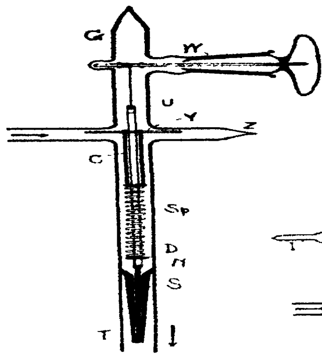

FIG. 2.

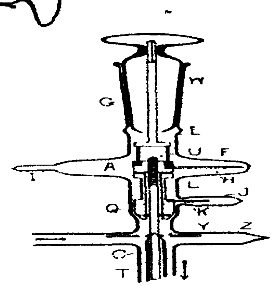

FIG. 3.

FIG. 1.

GT, Pyrex or Monax glass tube about 1 cm. in diameter.
S, Long valve seat made by drawing down capillary tubing, ring-sealed or waxed in position.
N, Valve needle made of copper wire tapered by dipping successively in acid.
St, Small steel rod for moving needle, fused to copper wire at *B*.
PP, Plugs of cork to guide steel rod, and to retain mercury.
Hg, Mercury for making air-tight seal around *St*. Mercury is retained between plugs *P*, *P*, so that valve may be used in any position.

FIG. 2.

GT, Pyrex or Monax glass tube about 1 cm. in diameter.
S, Long valve seat, same as in (1) above.
N, Valve needle same as (1).
U, Upper end of needle stem, copper rod.
D, Brass washer soldered to needle stem.
Sp, Heavy brass spring, rests on *D*, is held compressed against glass collar *C*, which in turn pushes against the yoke *Y*. Yoke is inserted through *Z*.
W, Winch for lowering or raising needle.

FIG. 3.

Pyrex or Monax glass, upper half about 1.5 cm. in diameter.
Glass collar turned through 90°, showing the position of yoke *Y*.
Valve stem threaded at upper end.
Brass supporting collar seated on shoulder in glass tube.
Slot in collar, and pin through needle stem.
Stud to keep collar from turning, inserted through *J*.
Flat enlargement blown in glass tube to allow pointer *H* to swing with nut A in fitting needle stem *U*. Enlargement carries a paper scale on outer circumference.
Nipple for inserting pointer *H*.
Spanner wrench.
Winch for engaging upper end of spanner wrench in turning nut *A*.

slowly, and yet it should have wide range. I have recently designed such a valve. The idea is not new; any originality that the device may have lies largely in the mechanical arrangement. Three forms, all employing very long and exceedingly narrow needles, are herewith described. The order is that of increasing complexity. The last one admits of being calibrated.

(1) This adjustable leak is very simple. It was suggested and constructed by L. P. Garner, graduate student in electrical engineering and physics, and was recently used in our laboratory in the determination of pump speeds by the mercury pellet method.[2] The essential parts are shown in Fig. 1.

In constructing this valve (and the two that follow) considerable care must be taken in seating the needle. It should be ground in with rouge before placing the valve seat in position. Obviously the needle in this form is adjusted by hand.

(2) The second form of needle valve requires a little more care in glass-blowing. The adjustment of the needle is accomplished by a stiff spring actuated by a winch. This valve was designed and constructed by me while at the Cavendish Laboratory, Cambridge, and during the past year was used by Prof. G. L. Clark, of the University of Illinois, in connexion with a Hadding-Siegbahn gas-type diffraction X-ray tube. The pressure was maintained constant at 0·011 mm. of mercury for periods of 50 hours on continuous runs, using an ordinary type of mercury vapour pump supported by a Cenco-Hyvac oil pump. The essential parts are shown in Fig. 2.

This valve needle seats tightly, depending on the stiffness of the brass spring *Sp*. For this reason the winch *W* should be made rather rugged. It is well to make the squared aperture engaging the winch rod as shown in Fig. 2, instead of placing it at the end of the plug, where the strains are liable to crack the glass. Use a stout grade of white linen thread.

(3) The third form of adjustable leak differs from the second in the mechanism employed for raising and lowering the needle. This mechanism is sketched in Fig. 3, in which the lower part of the valve is omitted. As in Figs. 1 and 2, the construction is made clear by reference to the letters assigned to the various parts of the figure.

Referring to Fig. 3, the upper end of the valve stem, the yoke, the supporting collar, nut, and spanner wrench are all of metal (preferably brass), and the remainder is of glass. The valve stem *U* must move freely through the glass collar *C* and through the brass supporting collar *L*. The nut *A* rests on *L*. The slot *Q* should be of sufficient depth to allow an overall up-and-down movement of the valve stem *U* of about 1 cm. This will give a wide range of leaks. By means of the pointer *H* and attached scale any setting may be repeated.

Finally, the successful operation of these leak valves, especially when a minute leak is desired, depends upon the care used in drawing into shape and seating the long needle valve.

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[1] Kaye, "High Vacua," p. 51; Hopfield, *Amer. Jour. Optical Soc.*, 12, p. 391; 1926.

[2] Kaye, *ibid.*, p. 162.

The Velocity Coefficient for Bimolecular Reactions in Solution.

IN a letter under the above title in NATURE of May 12, the interchange of energy between solvent and dissolved reactant molecules is discussed. This matter was considered in a paper entitled "The Benzylation of Amines: Part 3," in the *Journal of Physical Chemistry*, 673; 1926. If activated molecules of solute are deactivated by collision with solvent molecules, the latter molecules may either acquire a higher velocity, or be themselves activated,

or radiation may be emitted, for the energy absorbed from the activated solute must go somewhere. The molecules of the solvent cannot acquire a higher velocity unless the temperature of the solution rises. I do not know whether there is any experimental evidence in support of this; what it amounts to in a simple case appears to be that if we isolate two vessels, one containing, say, benzene, and the other a solution of a reacting substance such as benzyl bromide in benzene, then the temperature of the latter should rise. If the reply is that unactivated molecules of the reactant absorb this energy of translation of the solute molecules, then the position is as suggested by Mr. Louis Kassel (NATURE, May 12), namely, that the effect of the third molecule, the solvent, should probably be as often activational as deactivational.

If it be assumed that the activated solute gives up its energy to the solvent by activating the solvent molecules, then, unless we assume that the distribution of activated solvent molecules is upset by the presence of the solute or reactant, these activated solute molecules will presumably sooner or later transform their energy to the form of kinetic energy, and the position will be as before. We can again consider an actual case, a pure solvent, for example, benzene and a solution such as benzyl bromide in benzene. The pure benzene will contain a certain proportion of activated molecules, the proportion being governed by the usual $e^{-E/RT}$ relation. Is this proportion upset by the addition of the reactant benzyl bromide? If we go on to consider the case of a solution in which bimolecular reaction is actually taking place, then since the activated reactant molecules are disappearing as a result of the reaction and the solute molecules are not, one would expect that the more probable direction for interchange of energy would be from solute to reactants.

There is another question which appears to me still open and unexplored. Is it justifiable to assume that the number of activated molecules present is actually given by the expression $e^{-E/RT}$ in the case of complex organic substances, or is it not possible that in such cases one may get what may be described as electron tautomerism, with the activated and the ordinary forms in more or less stable equilibrium as has been suggested by Baly? The ordinary equation for the distribution of energy would then only apply in a modified form to such systems, and the velocity of reaction would depend considerably upon the life of the activated molecules (*cf. J. Phys. Chem.*, 535; 1927). Conditions in a solution are peculiarly favourable to the stabilisation of such 'electron tautomerides,' because the solvent molecules themselves can surround activated molecules and help in the production of a fairly stable system in which one or more of the electrons in the reactant molecule may be displaced from their ordinary positions by the absorption of the energy of activation. In effect, the solute would imitate feebly the behaviour of solute and solvent on ionisation.

This brings us back to the original Arrhenius conception of active molecules as a separate species, and remembering that Arrhenius based his conclusions on the behaviour of complex organic molecules in solution, it is possible that later extensions of his views derived from the behaviour of simple molecules in gaseous systems will not apply to more complex cases without considerable modification.

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Is Crystal Reflection of X-rays entirely a Classical Phenomenon?

IN a recent letter in NATURE of June 23, p. 983, Prof. G. E. M. Jauncey and Mr. W. D. Claus have made some remarks concerning the treatment of X-ray scattering by means of the new mechanics, and in this connexion we feel that the following comments may not be out of place.

According to the wave mechanics, the coherent and incoherent components of the scattered radiation are given by separate rules. It so happens that, over a wide range of wave-lengths, it is possible to give a picture of the process of coherent scattering by replacing the electrons by their corresponding Schrödinger charge density and supposing each element of this to scatter according to classical laws, but this by no means implies that crystal reflection is an entirely classical phenomenon.

Jauncey and Claus give the formula

$$(1/Z)\sum_{n=1}^{n=\infty}(-1)^{n}F_n = \tfrac{1}{2}, \qquad (1)$$

F_n being the F value for one atom, containing Z electrons, corresponding to the reflection of the nth order by a crystal of spacing D. We have been unable to see the justification of all the steps in their deduction of the formula, and have thought it worth while to check the result in the following way.

According to the wave-mechanics rule just given, we have

$$F(\sin\theta/\lambda) = \int_{-\infty}^{+\infty} P(a)\exp\left\{i\frac{4\pi a}{\lambda}\sin\theta\right\}da, \qquad (2)$$

$P(a)da$ being the total Schrödinger charge, expressed in terms of the electronic charge as unit, between two planes at distances a and $a+da$ from the centre of the atom. Putting $(\sin\theta)/\lambda = n/2D$, and assuming the charge distribution in the atom to be symmetrical with respect to a plane through its centre, parallel to the reflecting planes, we find by a simple summation

$$-\sum_{n=1}^{n=2N}(-1)^{n}F(n/2D) = Z/2 - \tfrac{1}{2}\int_{-\infty}^{+\infty}P(a)\frac{\cos(2N+\frac{1}{2})2\pi a/D}{\cos\pi a/D}da.$$

Assuming $P(a)=0$ for $a \geq \frac{3}{2}D$, that is that the atomic radius is less than one and a half times the spacing of the planes, it follows that

$$-\sum_{n=1}^{\infty}(-1)^{n}F(n/2D) = Z/2 - DP(D/2), \qquad (4)$$

a result which has been given by Compton for the special case $P(a)=0$ for $a > D/2$, in which the second term on the right-hand side of (4) vanishes. Formula (4) is also true when heat motion is taken into account, if a suitably modified $P(a)$ is used, and if the generally scattered radiation is neglected.

Jauncey and Claus use the experimental results of Havighurst to check relation (1), and find it to be true in three out of the four cases chosen. In one case the sum of the series is greater than $\frac{1}{2}$, but it must be pointed out that the experimental F curve has been extrapolated in both directions, so that no definite conclusion can be based upon it.

Moreover, formula (4) is only true for very large values of N; for small values, and with a suitable distribution $P(a)$, the integral in (3) may assume negative values, so that care is evidently required in applying the formula to a small number of spectra. It seems scarcely possible to decide for or against any theory of scattering by a method of this kind. There is in fact a very close agreement between the F curves

calculated for sodium and chlorine according to the rule given above, and the observed F curve when proper corrections are made for temperature (James, Waller, and Hartree, *Proc. Roy. Soc.*, A, **118**, 334; 1928), and we feel that this is much the most direct type of test to which the theory can be subjected.

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Kinetics of Absorption of Ultra-sonic Waves.

RECENT work by Pierce (*Proc. Amer. Acad. Arts ınd Sci.*, **60**, No. 5; 1925, and Abello, *Proc. Nat. Acad. Sci.*, **13**, p. 699; 1927) has directed attention to the ıigh attenuation experienced by ultra-sonic waves in ɔassing through carbon dioxide and, to a lesser extent, ıydrogen or helium. It is possible to correlate this ıbsorption and the attendant frequency variation of elocity with the mechanisms of collisions of the first und second kinds.

The mean kinetic energy of the molecules varies 'rom the regions of rarefaction to those of condensa ion, so if we associate with each small volume element a corresponding temperature, we may speak of the ranslational energy temperature variation in space und time. For low sound frequencies the collision nechanism is adequate to allow the distribution of nolecules in the internal states to readjust itself to the slow fluctuations in translational temperature. Using e language of the old quantum theory, we define for each stationary state an associated temperature for which under equilibrium conditions the number of nolecules would be that actually present for par ticular space-time values. For increasing frequency there is a phase lag and also a diminution in the rela tive amplitudes of the internal and translational energy temperature variations. This amplitude diminution is slight for some states and more marked others. Accordingly, the gas begins to behave as these latter states were absent and others only tially present: or, put otherwise, the specific heat reases and the velocity of sound increases. The sorption on this theory is due to the out-of-phase nponents in the internal temperature changes, and o to the radiation loss of energy from excited states. e detailed analysis will be published in the *Physical view*—the final results (except for some idealised ses for which reference may be made to Jeans's Kinetic Theory of Gases" and to Herzfeld and Rice, *ysical Review*, April 1928) involve collision excita n probabilites and co-ordinate the experimental nd data with atomic structure knowledge.

Evidently, increasing the collision frequency acts to ninish the discrepancy between internal tempera res and the translational temperature. General nsiderations (applicable also if a viscosity explana n is offered) suggest that the absorption coefficient to a first approximation dependent directly on the mber of molecules in the path of the sound beam and versely on the frequency of collision. It may then shown that in a mixture of gases A and B, the ratio the resulting absorption to the absorption of pure at the same pressure is

$$e^{x(aN_A^2-bNN_A)/aN_A^2-bNN_A+cN^2}$$

ere N and N_A refer to the concentrations of mole les of both types and of type A alone, respectively; is proportional to sound path length, and the con ants a, b, c satisfy the inequalities $c>b>a\geq 0$. $a\neq 0$ one assumes that because of resonance or coupling fects collisions between similar molecules are on the average more effective in promoting energy transfers than collisions between dissimilar ones.

Abello's empirical conclusion from his data was that the exponent supra is proportional to N_A. However, on referring to Abello's graphs for hydrogen and carbon dioxide, it is seen that the experimental absorption for N_A large is uniformly greater than predicted on his assumption of a linear dependence and seems rather to bear out the relation given above.

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May 21.

Abstracts of Royal Society Papers.

THE issue of NATURE of Mar. 24 contained a paragraph (p. 483) referring to a paper entitled "Statistical Experiments on the Motion of Electrons in Gases," by Mr. R. d'E. Atkinson, communicated to the Royal Society at a meeting on Mar. 15. Previous to the meeting the abstract of this paper written by Mr. Atkinson had been circulated to members of the Society.

The abstract contains definite statements which have led uninformed readers to believe that there are many errors in my publications on the subject of electricity in gases and in those of other physicists who have collaborated with me. Several people interested in this subject have expressed surprise that no answer has as yet appeared to the statements contained in the abstract.

I should like to direct attention to the fact that I wrote an answer to the statements contained in the abstract early in May and sent it to the *Philosophical Magazine*, but publication was refused on the ground that the abstract circulated by the Royal Society is not 'official,' and consequently no answer can be made to the statements contained in it.

If this view be accepted, it becomes possible for authors to have statements circulated and placed in a position so privileged that there is no opportunity of answering them except in a foreign journal.

It is perhaps not generally known that even after an 'abstract' has been circulated, the whole paper, or parts of it, may be refused publication by the Royal Society.

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Oxford, July 11.

Does Methylene Blue penetrate Living Cells?

MISS IRWIN (NATURE, June 16, p. 939) implies that her observations affect the validity of vital staining with methylene blue. As one who has used this method extensively, may I ask whether the method depends upon "penetration of blue dye" as Miss Irwin assumes?

A muscle nerve preparation taken from a frog previously transfused with dilute solution of methyl ene blue behaves like a normal physiological prepara tion in respect of vigorous contraction on electrical stimulation through its nerve for upwards of an hour after the appearance of intensely stained nerve-endings. The muscle itself appears pale green by transmitted light, and the dye is evidently present in a reduced or partially reduced form. This applies to the whole of the muscle; but it is rare for more than half the nerves to be stained. I suppose the contracting muscle is alive; to think otherwise would do some violence to accepted vital criteria.

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June 20.

Agriculture in India.

INDIA nowadays is rarely without its Commission, and these follow one another in rapid succession. The most recent one reporting is the Royal Commission on Agriculture,[1] which has been at work for the past two years, somewhat overshadowed latterly by the Simon Commission. The short title is rather misleading, for the terms of reference cover much wider ground: these include the "present position of agricultural and rural economy in India," and the Commission is asked to make "recommendations and to promote the welfare and prosperity of the rural population." Specifically mentioned besides agricultural and veterinary practice, are agricultural statistics, better crops and improvement in practice, dairy farming and breeding of stock, as well as methods of transport and marketing, agricultural finance and credit. But the intention of His Majesty's Government is perhaps more clearly indicated by the composition of the Commission, which includes no member of the Indian Agricultural Service.

For those, then, who might naturally look for a careful survey of the many problems facing Indian agriculture, the report will be somewhat disappointing. For a study of such questions they will have to depend chiefly on the mass of evidence which is now being published. The Commission contents itself, so far as the improvement of agriculture is concerned, with some 50-60 pages, but devotes a larger number of pages to the agricultural services and their organisation, having among its members those eminently fitted for dealing with this.

The Commission, in its letter of submission writes as follows: "Throughout our Report we have endeavoured to make plain our conviction that no substantial improvement in agriculture can be effected unless the cultivator has the will to achieve a better standard of living and capacity, in terms of mental equipment and of physical health, to take advantage of the opportunities which science, wise laws, and good administration may place at his disposal. Of all the factors making for prosperous agriculture, by far the most important is the outlook of the peasant himself." When all is said and done, however, we do not think that the request in the terms of reference "in particular to investigate the measures now being taken for the promotion of agricultural research . . . the introduction of new and better crops, and improvement in agricultural practice," has received sufficient attention. The inclusion of experienced workers in these subjects would have strengthened the Commission, and rendered this part of its report more weighty and valuable.

The compact volume in which the report is printed runs to close on 900 pages, of which the first 100 are devoted to an unofficial summary, excellently written and of particular value to the general reader. We gather that the first step taken on landing in India was the preparation of the usual questionnaire, which was very freely distributed. Replies to this numbered 783, and 395 witnesses were examined during the two years. The mass of literature comprised of these written statements and the subsequent examinations should form a useful library on Indian agriculture, and the present conditions of the rural population.

The report opens with an introductory chapter on "The Village," the unit of rural India, which is entirely different from anything in Great Britain. It consists in the main of a collection of mud houses huddled together like a flock of frightened sheep, in the midst of the fields belonging to it. This arrangement dates from ancient times, and obviously makes for mutual protection, for the cultivators were defenceless against bands of marauders. Besides this, the demands of their rulers varied from year to year and were sometimes crushing; and there was always the fear of famine if the monsoon failed. Selling the produce from their fields was non-existent in a small community all growing the same crops, and each cultivator was content with producing only the amount required for his family. Later, with added security under a settled government, matters improved, and there was a new-found feeling of safety. The land was divided up and the rights of ownership examined and recorded, and for the first time land, irrespective of crops, acquired a value. Each member of the village knew what proportion of the produce was his own—but the arrangement of centuries remained unaltered. Of the 500,000 villages in India, most are still untouched by metalled roads or railways, and are thus cut off from one another by impassable paths during the rains.

There is in India a marked absence of large-scale farming. All agricultural practices are dependent on the stated periods of the monsoons, and work on the land in the long dry season becomes impossible. Thus for half the year the cultivator has his time on his hands. It is always hard to change old-time customs, but not the least problem engaging the attention of the Commission appears to be that of placing the cultivator in a position, by the most varied ameliorations, to make use of this idle time.

In the second chapter there is a summary history of the efforts at applying scientific agriculture to India, from the enlistment of twelve American cotton planters in 1839 "to teach the cultivators to grow and clean cotton," and the celebrated order placed in England in 1863 by the Madras Government for "a steam plough, steam harrows and cultivators, seed drills, horse hoes, threshing machines and winnowers, chaff cutters and water lifts," to the establishment in 1903 by Lord Curzon of the Indian Agricultural Department. When the constitutional changes occurred in 1919, all departments connected with rural welfare were 'transferred' from the Government of India to the local governors, each acting through a minister. This of course included agriculture, with the exception of the central research stations for all India.

[1] Report of the Royal Commission on Agriculture in India. (Cmd. 3132.) Pp. v + 100 + xviii + 755. (London: H.M. Stationery Office, 1928.) 11s. net.

In Chapter iii. the Commission, dissatisfied with the incoherence of the present arrangement, proposes a new organisation for agricultural research. This scheme, although the Commission is not quite unanimous in matters of detail, appears to be well thought out and of value. At present the agricultural departments in the provinces are independent of one another and of the central research institutes, which are under the control of the Agricultural Adviser to the Government of India. This lack of connexion between all India and provincial departments is, and always has been, an anomaly, and the new organisation is designed to bring them into closer relations. For this purpose the establishment of an Imperial Council of Agricultural Research, with a lump sum of 50 lakhs of rupees as endowment, is recommended; the primary function of the council will be to co-ordinate agricultural and veterinary research in India with that in other parts of the British Empire and foreign countries.

The Imperial Council of Agricultural Research would consist of three whole-time officers and 36 others. Of the three, the chairman should be of wide administrative experience and, if possible, with Indian experience also, and the two others would deal with agricultural and veterinary research respectively. The 36 ordinary members would represent various interests in the country: 8 would be nominated by the Government of India, 18 would represent the provinces, 3 the universities, each the Central Cotton Committee and the planting community, and the remaining 5 would be elected by the Council itself. The whole-time officers would be engaged for five years, and the rest nominated for three, periods subject to extension if desired. The post of agricultural adviser to the Government of India would naturally lapse under this scheme, and his advisory duties would be carried on by the chairman of the Council.

Special attention is directed to the Central Research Institute at Pusa. This, it is recommended, should be strengthened so as to become also a teaching centre for higher training in agriculture, as it is entirely desirable that India should be self-contained in this respect as soon as possible.

The allied subject of the agricultural services is dealt with in a long chapter (xix.) at the end of the report. While we consider it of even greater importance than that on the organisation of research, space forbids us from going into details. The general intention in the recommendations is to improve the status of these services, on the score of efficiency and because of the increased responsibilities imposed if the Commission's suggestions are endorsed. This applies not only to the rank and file, but in a special degree to the posts of provincial director of agriculture and the principal of the agricultural college, both of them being key positions in the improvement of agriculture. It is suggested that the hands of the former might be strengthened by the addition of an officer of somewhat lower status as joint director. The Commission is not in favour of short-term appointments—which are, it is true, generally uneconomic in principle and practice. As to the general recruitment for the service, it is recommended that the system of scholarships so successfully initiated by the Colonial Office should be adopted; and in the case of all superior officers it is contended that the best men should be engaged, and that therefore recruitment should not be confined to one province, or even to India. The Institute at Pusa is again referred to, and the Commission recommends that the status of the principal and the heads of sections should be raised, in view of the increased demands made upon them.

Chapter vi. is devoted to agricultural improvement, and it is stated that the various factors affecting crop production, other than irrigation, are dealt with. The areas under the seventeen chief crops in India are given for general information. Soils and manures are rather fully discussed and take up about half of the chapter, a few pages are devoted to plant breeding, and a table is printed showing the areas under improved varieties; rather more space is devoted to seed distribution; agricultural implements are then considered, and a few concluding remarks are made on plant protection. The important subjects of rotation of crops and tillage are not included, in that they have been fully discussed by the recent Sugar and Cotton Committees.

There are 81 recommendations and conclusions at the end of chapter vi, although this formidable number could have been reduced by using longer paragraphs. As examples of useful conclusions the following may be given: the suggestion that a soil survey of India should be undertaken is vetoed: no diminution in the fertility of long-continued cultivated fields is anticipated: definite advice cannot be given by the agricultural department on the use of fertilisers by cultivators: neither export tax nor prohibition of export, of oil seeds, oil cakes, bones or fish manures, can be justified; and no legislation is needed for the adulteration of fertilisers.

As already indicated, we consider that this chapter will prove disappointing to those interested in agricultural problems, and hoping for new light on an extremely complicated enterprise, in which, despite occasional successes, the general result of their labour has often been very disheartening. This latter aspect is reflected in the way in which the Commission has presented this part of its report; for there is a singular absence of that enthusiasm which is so marked a feature whenever they deal with rural economy. As it is, the chapter summarises the information placed before the Commissioners, and is simple and clear, with an honest attempt to make suggestions where considered of possible advantage. In many cases there is practically nothing to be done but to go on working, and the Commission accordingly has various suggestions for the new Imperial Council of Agricultural Research. But it must be remembered that this subject is rather beyond the experience of the Commission as constituted, and could only be dealt with properly by a committee of experts in the various agricultural sciences, and in the practical aspects of Indian agriculture: such a body alone would be competent to collate the evidence and to discuss the improvement of Indian agriculture.

(To be continued.)

Reproduction, Lactation, and Vitamin E.

As the dietary requirements for growth have become more clearly defined with the introduction of purified nutrients, it was soon observed that diets adequate for growth might not suffice for reproduction or lactation, either quantitatively or qualitatively. Quantitative deficiencies are easily remedied: investigation of the qualitative has led to a better appreciation of the part played by protein, salts, and vitamins in nutrition, and to the discovery of a new type of sterility. The young are dependent for their supplies upon the mother until they are weaned: inadequate diets during pregnancy are reflected in the condition of the young when born or later: during lactation such diets result in failure to rear the offspring. The growing organism requires different ratios between the various elements of the food as compared with the adult and the qualitative dietary requirements of the nursing mother depend chiefly on the necessity of satisfying these needs. Thus a relatively greater intake of certain salts and growth-promoting vitamins is required by a nursing mother than by an adult of the same weight who is not being subjected to a similar strain.

Failure of reproduction is a characteristic effect of many deficient diets and is usually shown by failure to breed or by failure to rear the young born. A special type of sterility has been described by H. M. Evans and his co-workers and shown to be associated with a dietary deficiency: the substance lacking is apparently an organic compound of unknown composition; it has been labelled vitamin E. Our knowledge of this vitamin has recently been collected by H. M. Evans, G. O. Burr, and T. L. Althausen ("The Antisterility Vitamine Fat Soluble E," *Memoirs of the University of California*, vol. 8). The sterility is unique in that implantation of the embryos in the uterus occurs normally, but later they are resorbed and no young are ever born. The sexual cycle in female rats suffering from vitamin E deficiency occurs normally: in other types of sterility, either the sexual cycle is disordered or implantation fails to occur. In the male, vitamin E sterility is accompanied by degeneration of the testicular glands.

To determine whether a given rat is suffering from vitamin E sterility it is essential to carry out fertility tests. The occurrence of œstrus or pro-œstrus must be observed, from the change in type of cell found in a vaginal smear, and must be followed by the signs of successful copulation with a fertile male, the presence of a vaginal plug and spermatozoa in the female passages. If implantation is successful the vaginal smear shows red-blood cells about the 13–15th day of gestation. In the authors' stock of animals, 5-18 per cent of successful matings are not followed by implantation: the animals used for testing for the presence of vitamin E should not show a higher percentage of failures, otherwise they are unsuitable for the test and are presumably suffering from some other type of deficiency. Resorption of the young occurs about the 20–25th day and is shown by a gradual fall in weight of the animal, in contrast to the abrupt fall seen when a litter of living young is born. The suitability of the animal for the test can be controlled by supplying a source of vitamin E at the next gestation and obtaining a healthy litter.

Histological examination of the uterus of these animals at different stages of gestation shows that the development of the young is definitely retarded after the 8th day: about the 13th day many of the fœtuses die and the placentæ start to degenerate about the 16th day. Death is ascribed to changes in the yolksacs, especially interference with hæmatopoiesis and failure of development of the fœtal capillaries in the placenta. The fewness of the red-blood corpuscles as compared with the numbers seen in normal embryos is noticeable about the 11th day.

In contrast to the normal sex-life of the sterile female, the sterile male shows marked testicular degeneration. For a short period a male may be sterile and show normal testes histologically: that some change has already occurred in the organs, however, is shown by the fact that even prolonged administration of vitamin E will result in the cure of only 25 per cent of sterile males, and even in these most of the tubules will be degenerated. In the next stage the spermatozoa fail to show normal movements, and finally disappear: the animal becomes incapable of forming the vaginal plug on copulation with the female and in the last stage loses all sex interest.

The diet used to produce these effects contains alcohol-extracted casein, cooked corn starch, cod liver oil, salts, lard, and yeast: it is thus adequate so far as the other dietary constituents are concerned. Sterile females supplied with a sufficiency of vitamin E will have a normal gestation and produce living young: by using such animals as test objects it has been possible to determine the distribution of the vitamin in Nature and to prepare extracts containing it in concentrated form. In general it may be stated that animal foods are not good sources of the vitamin: it is not stored in the testes and the viscera contain little: it is chiefly present in muscle and fat, though even here it is not in a concentrated form: milk contains little. Vegetable foods provide the most potent sources, especially lettuce and wheat-germ: the oil extracted from the latter has proved a convenient source. Fertility can be ensured by a dose of 0·55 gm. of the oil on the first day of gestation or by a daily dose of 25 mgm. during gestation. Experiments have shown that for any given gestation to be successful the vitamin must be present in adequate concentration in the body from the 5th to the 20th day of this gestation. Twenty times the minimum dose will suffice for two but not for three gestations: the vitamin is used up in the ordinary metabolic processes of the body, and although it is essential for gestation it does not appear to be utilised more rapidly during it. Sterile animals

contain less of the vitamin in their tissues than those on an adequate diet: it can be detected also in new-born young. It exerts its action on intraperitoneal injection as well as following oral administration. In excess it will not increase the fertility of the animals above the normal for the particular stock.

Preliminary experiments appear to show that vitamin E is also essential for normal lactation.

As regards its chemical properties, vitamin E shows close relationships to the group in which vitamins A and D are placed: it is found in the unsaponifiable fraction of wheat-germ oil, but is unstable to a hot saponification in this oil, although stable when in a purer condition. It is stable to aeration and hydrogenation but not to bromination: it is not destroyed by drying lettuce nor by cooking plant or animal tissues. By fractionation of wheat-germ oil a sterol-free fraction can be obtained, distilling at 225-230° C. at 0·01 mm. pressure, containing all the activity: no nitrogen, sulphur, or halogen is present in the active fraction, 5 mgm. of which fed on the day of mating will suffice to ensure a normal gestation. Its behaviour on fractionation thus resembles closely that of the growth-promoting fat soluble vitamin A.

Failure of reproduction on similar synthetic diets has been noted by other observers, especially by B. Sure, but Evans and his co-workers have made the most complete analysis of this particular type. U. Suzuki, W. Nakahara, and N. Hashimoto (*Proc. Imp. Academy*, Tokyo, vol. 3, p. 619; 1927: *Scientif. Papers, Instit. Phys. and Chem. Research*, vol. 7, p. 143: 1927), have obtained failure of reproduction with degeneration of the testes in the males, but without demonstrable changes in the ovaries in the females, when white rats were maintained on diets free from, or relatively low, in fat, vitamins A and B being supplied in the form of concentrates. Their diets, however, failed to secure absolutely normal growth. Evidence of resorption of embryos was obtained in a few of the females. It is probable that the results were due to vitamin E deficiency. W. P. Kennedy (*Quart. J. Exp. Physiol.*, vol. 16, p. 281; 1926) has also confirmed some of the details of Evans' work.

It may be pointed out in connexion with the examination of food materials as sources of certain of the vitamins, that there is some evidence that erroneous conclusions may be drawn when the substance under test is mixed in with the other constituents of the diet, owing to an interaction between it and some of these constituents resulting in a destruction, partial or complete, of the vitamin. Thus H. A. Mattill (*J. Am. Med. Ass.*, vol. 89, . 1505; 1927) has adduced evidence that vitamins . and E may be oxidised in the presence of certain ts or salts in the diet: and H. M. Evans and O. Burr (*ibid.*, vol. 88, p. 1462, and vol. 89, 1587), have obtained similar results in the case vitamin E. Lard among the fats and ferrous lphate among the salts appear to be among the structive agents: a definite relationship between lard and the amount of wheat-germ necessary to cure sterility has been demonstrated: hydrogenated lard appears to be without this effect: a ferric salt has not the same action as a ferrous salt.

Although so much attention has been recently directed towards the part played by the vitamins in reproduction and lactation, it is essential that the influence of the other constituents of the diet and the proper balance of all the constituents should not be omitted from consideration. Gladys A. Hartwell (*Biochem. J.*, vol. 21, p. 1076; 1927), using a diet of caseinogen, potato starch, butter, cod-liver oil, salts, and marmite, found that 16 per cent butter or 12 per cent with 4 per cent cod-liver oil and 16 per cent caseinogen produced nearly normal growth in rats: with 14 per cent cod-liver oil growth was less good, and no litters were produced: the uteri and mammary glands were abnormal and the testes in the male were frequently small and the animals sterile. With 16 per cent butter and 4 per cent cod-liver oil, reproduction was poor, the does dying or failing to rear their young: the males were fertile. Increasing the protein content or adding lactalbumin gave slightly better results, but the best were obtained with 12 per cent butter alone in the diet, although still not so satisfactory as among the animals of the stock colony. She suggests that excess of vitamins A and D may upset growth, or that vitamin E is necessary for growth as well as for fertility: it is possible that interaction between the constituents of the diet in the diet itself may be a factor in the results obtained: thus the cod-liver oil may inactivate the vitamin E of the butter. The same author has also shown that potato protein is inadequate for growth, reproduction, and lactation, probably due to the difficulty of feeding sufficient protein on a simple potato diet (*ibid.*, p. 282), and that an oatmeal diet, although it allows of fairly good growth, is not adequate for reproduction or lactation (*ibid.*, vol. 20, p. 750; 1926). In this case also the total protein in the diet was low. W. P. Kennedy (loc. cit.) has found that fertility is impaired by a high protein diet and also by one low in calcium, and that the movements of the isolated uterus of these animals in a bath of Ringer's solution may not be absolutely normal, as well as the response to variations in the calcium content of the surrounding fluid (*Quart. J. Exp. Physiol.*, vol. 16, p. 333; 1926).

U. Suzuki and N. Hashimoto (*Scientif. Papers, Instit. Phys. and Chem. Research*, vol. 4, p. 236; 1926) found that on a diet of condensed milk supplemented with salts and a vitamin B concentrate, growth was normal but reproduction rare: fertility was improved by the addition of 0·1-0·5 per cent cholesterol. These authors also report that a higher proportion of cholesterol in the diet was toxic, leading to cessation of growth and even death: there appeared to be a relationship between this toxic effect and the vitamin A content of the diet.

Apart from the reflection of the adequateness of a diet in the number and condition of the young

born—if the diet is so far adequate for reproduction —the condition, and especially the weight of the mother, form an index of its suitability. Miss Hartwell (*Biochem. J.*, vol. 21, p. 572; 1927) has found that on a variety of diets the mother rat gains about 20 gm. in weight during gestation, whether the diet is good or poor: in the latter case there are fewer young in the litter and many are born dead. On the other hand, during lactation the mother may lose up to one-third of her weight in supplying the needs of her young, if the diet is inadequate. Thus it appears that the mother only sacrifices her own tissues during lactation and not during gestation. S. Bartlett has found that cows also continue to grow during gestation and lactation provided that their diet is satisfactory (*J. Agricult. Sci.*, vol. 16, p. 392; 1926). The necessity of proper diets is further shown by some figures published by Forbes and his co-workers (E. B. Forbes, J. A. Fries, W. W. Braman, and M. Kriss: *J. Agricult. Research*, vol. 33, p. 483; 1926). From metabolism experiments on cows it is concluded that the percentage utilisation of the metabolisable energy of the ration for maintenance reaches 75-80, for production 70-75, but for growth only about 60. Similar studies, which include milk analysis, can scarcely be carried out on rats owing to their small size, so that it is of interest to bring together the results obtained in the case of these two species of animals, and to note the similarity of their behaviour during gestation and lactation.

News and Views.

THE scientific and economic problems of the textile industry, to the importance of which considerable attention was paid at the Leeds meeting last year of the British Association, form the theme of several recent publications. Two noteworthy communications are "A Survey of Textile Industries" by Sir Arthur Balfour's Committee on Industry and Trade, and "A Survey of the Production and Utilisation of Wool," published by the British Research Association for the Woollen and Worsted Industries. The latter report is of a very general character. It summarises the extensive nature of the problems of the industry, and attempts to indicate lines of investigation for the improvement of the world's wool production for the particular purposes of textile manufacturers. Some of the observations made in the report are not very specific. The importance of the study of the "growth of wool on the living sheep, how it originates, how it develops, and how it attains its final form, and, above all, why fibres differ, why fleeces differ, why breeds differ," is of course obvious. But this matter seems to involve just those difficulties which make the answer to some of the fundamental biological problems a matter of the greatest interest and complexity. The report clearly emphasises the urgent necessity for a real systematisation and definition of certain properties of the wool fibre. It suggests a possible classification of wools from the point of view of their utility to the spinner and manufacturer, in accordance, first of all, with their milling properties, and, secondly, with their spinning powers.

THE real difficulty of progress in these matters depends on the fact that the fundamental properties of wool from the viewpoint of the spinner and manufacturer, if they are actually definable, are certainly not yet defined. The spinning power of a wool, it is true, is related to its quality, yet, as was pointed out in NATURE of Nov. 19, 1927 (p. 730), the quality number or count to which a particular wool will spin has at present no definite measure. Exact information upon the important processes of milling and felting is also not available. It is not surprising that one finds in these circumstances that "the blanket manufacturer knows exactly [the type of raw wool] which he requires, though not always is he able to express it in words." As the report states, unless the fundamental properties of a raw wool are known in its relation to the purposes for which it will ultimately be used, experiments for developing new types of wool are bound to be of doubtful value. The wool textile technologist has conditions to meet, however, in connexion with the raw material, which scarcely exist in connexion with the supply of the raw material for other industries. For example, supplies and qualities of fleeces can under certain conditions be controlled, but, as Sir Arthur Balfour's committee points out, "the expansion of wool supplies [and presumably the quality] seems likely to be largely dependent on the price of wool (conjoined with the price of mutton) in relation to the price of other agricultural produce, notably, wheat and cereals." This aspect of the raw material supply for the textile industry, while it does not of course form directly a part of the problem of the standardisation of wool by scientific means, is bound to receive considerable attention by the economist and agriculturalist. Its relation with the technological points enumerated in the report of the British Research Association for the Woollen and Worsted Industries has doubtless already taken an important place in the considerations of that body.

SCIENTIFIC workers generally will welcome the statement made in the House of Commons on July 23 by Mr. A. M. Samuel, Financial Secretary to the Treasury, that the Government is prepared to exempt from Customs duty scientific cinematograph films brought into Great Britain solely for exhibition to scientific bodies. As was stated in our issue of July 21 (p. 103), the subject was raised early this month as a direct consequence of the difficulties experienced by Mr. W. H. Wright, the distinguished American astronomer who delivered the George Darwin lecture before the Royal Astronomical Society on June 8, in introducing his cinematograph film of Jupiter. On the report stage of the Finance Bill in the House of Commons on July 23, Capt. Ian Fraser moved a new clause providing that the Customs duties imposed by the Finance Act, 1925, on negative and positive cinematograph films should cease to be payable in the case of a film certified by the Royal Society to be

solely an illustration of scientific investigation, for exhibition before members of a recognised scientific body and imported only for the purpose of such exhibition free of charge. Mr. Samuel stated that the Royal Society has agreed to certify such films, and that the Customs officials will accept the statement. Capt. Fraser's clause was therefore read a second time and added to the Bill.

IN his presidential address at the British Pharmaceutical Conference, delivered at Cheltenham on July 24, Mr. R. R. Bennett took as his subject "Recent Biochemical Discoveries in Relation to Pharmacy," and illustrated their relationship by reference to some of the recent work on the hormones and vitamins. Pharmacists are especially interested in this work from the point of view of the standards of purity and activity adopted, which, since many of the substances under review are of unknown chemical constitution, are based ultimately on biological tests. The standards adopted by the Health Committee of the League of Nations and by the Therapeutic Substances Act, 1925, may be taken as examples of the standards of reference which will be included in the new edition of the "British Pharmacopœia": pharmacists should be familiar with these standards and also with the methods of biological assay by means of which the activity of any preparation may be evaluated in terms of the standard. Mr. Bennett illustrated his thesis by referring to some of the recent work on the pituitary and thyroid glands, on the ovarian hormones, on insulin, and on the extract of liver which is effective in the treatment of pernicious anæmia: the isolation and synthesis of thyroxine and the separation of the oxytocic and pressor principles of the posterior lobe of the pituitary gland were included in this section. In that on the vitamins special attention was directed to the recent work on the production of Vitamin D by irradiation of ergosterol. Reference was also made to the recent work on Vitamin B, including its differentiation into two separate accessory factors, and criticism directed to the standard for Vitamin A laid down in the "United States Pharmacopœia." In conclusion, Mr. Bennett referred to the interest shown in the development of biochemistry in its relation to pharmacy by the Pharmaceutical Society, as evidenced by the recent inauguration of the Society's Pharmacological Laboratories.

A USEFUL conference was held by the Association of Lighting Engineers at Sheffield on July 9–16. The discussions on road lighting, from the point of view both of the pedestrian and the car driver, were valuable, as they show how complex the problem is, depending as it does on difficult questions of physiology and psychology. The pedestrian wants to see small obstructions on the road and the numbers on the houses; the driver wants, in addition, to be able to pick out objects at a considerable distance in advance without the necessity of using his head lights. The two principal factors which enable objects to be distinguished by the eye are the contrast in brightness between the object and the background, and the shadow cast by the object itself. Experiments indicate that the mechanism of visibility is not the same at high as at low illuminations. At high illuminations diversity of brightness plays the principal part.

IT was pointed out by Mr. Waldram during the Sheffield conference that in one installation the street was illuminated evenly all over with minimum intensity. The illumination produced was like moonlight, and only in a few positions could pedestrians be distinguished. In another test the light was partially cut off so that dark streaks were produced across the road. In this case every pedestrian could be easily seen. The difference between the illumination produced on rough and smooth road surfaces by given light sources was also emphasised. On a polished road longitudinal streaks are formed running from the observer to each light source. The best way of detecting an obstruction is to watch whether any of the streaks are blocked out. It was generally agreed that it is inadvisable to have the light sources all on one side of the road. With polished or wet roads this system is dangerous. For narrow roads it is good to have the alternate lamps on opposite sides of the road, but for wide roads it is best to have the sources arranged evenly on each side of the road. The sources should be shaded from the driver's eyes, but the light should not be cut off from buildings and kerbs.

THE Association of British Chemical Manufacturers held its twelfth annual general meeting on July 12 under the chairmanship of Mr. C. A. Hill. Mr. Hill said that the Council considered it inadvisable to patronise more than one exhibition in each year, and recommended that the exhibition supported should be the British Industries Fair, to promote the success of which everything possible should be done. He referred to the work of the Resistant Metals Committee, remarking that the chemical industry is in great need of new materials for the construction of plant dealing with corrosive substances, and expressing the hope that important results would emerge from the concentrated and co-ordinated attack on the problems involved. Sir Max Muspratt reminded his audience that the 'safeguarding' policy is a double-edged sword; if they wanted the tariffs of the world reduced they must not be too exigent as to the terms they asked for safeguarding their own industries and the retention of the Dyestuffs Act. The A.B.C.M. monograph on chemical industry showed that, broadly speaking, Great Britain is a free-trade nation, although exceptions were forced upon it in respect of small sections of an enormous chemical industry. The Right Hon. J. W. Wilson spoke of the growth of big combines from small businesses, and of the relations between them. The honorary treasurer, Dr. E. F. Armstrong, expressed concern at the large number of foreign patents which have recently been taken out in Great Britain. These were, for the most part, not genuine inventions, but were taken out with the object of preventing British manufacturers making or using substances which often were well known. He suggested that the matter is one for the close attention of the Patents Committee. Further, he declared that the industry

is still in need of protection of the type afforded by 'safeguarding' and the Dyestuffs Act, a view wl ch was emphasised also by Mr. Dawson.

THE rapid improvements that are being madc in connexion with broadcast receiving apparatus or applying electrical devices to improve the gra o-phone, make it advisable to consider prob le future developments. It is known that the qua ty of reproduction from a modern gramophone rec rd can be greatly improved and the volume of the sou id more easily controlled when electrical methods of reproduction are employed. The vibrations of ne needle can be made to generate currents by me ns of what is called a 'pick-up' attached to the t ne arm of the gramophone. These currents, a er passing through a powerful amplifier, operate a l id speaker. The amplifier and loud speaker circ t, being the same as that used in broadcast reception, un be used for either purpose. For many homes in ne future it seems probable that they will have bro l-cast receiving apparatus with eliminators wh :h obviate the use of batteries, and an electric ly driven gramophone turntable. The present tr id of development seems to be in the direction of hav ıg a fixed electrical installation which can be control d and heard in many rooms of the house. Some co - tractors have already made such installations, b they are still regarded as luxuries. In building ne houses, the advisability of leaving conduits for po - sible requirements should be considered. It is possib that in the future we may have towns with as mar as 50,000 private consumers, taking about 20 30 watts of electrical power for reproducing mus mechanically for entertainment purposes. In th case a dynamo of at least a thousand kilowatt capacit would be required to supply them.

ACTIVE preparations are being made for tl quadrennial International Congress of Mathemati to be held on Sept. 3–10 at Bologna. The business the Congress is to be transacted in seven section: (1) Arithmetic, algebra, analysis; (2) geometry; (3 mechanics, astronomy, geodesy, geophysics, physical mathematics, theoretical physics; (4) statistics mathematical economics, calculation of the proba bilities, science of the actuary; (5) engineering anc industrial applications; (6) elementary mathematics didactical questions, mathematical logic; (7) philo sophy, history of mathematics. In each section ar attractive programme of lectures by experts has beer arranged. On the social side, the national govern ment and the cities of Bologna, Florence, Ravenna Ferrara will give receptions. The visits organisec will include important engineering works on the Tuscan-Emilian Apennines and the hydro-electric plant on the Lake of Ledro, near Lake Garda. A subscription of 50 lira will entitle a member to a copy of the *Acts* of the Congress, also to reduced fares on the Italian State railways between Aug. 20 and Sept. 30. Intending members should communicate first with Alla Commissione Esecutiva del Congresso Internazionale dei Matematici, Instituto Matematico della R. Università, Bologna, Italy. Delegates have been appointed by the Universities of Aberdeen, Belfast, Birmingham, Cambridge, Edinburgh, Glasgow, Manchester, Oxford, St. Andrews and Toronto and Columbia University, the Royal Society of Edinburgh, and the Cambridge Philosophical Society.

THE nineteenth International Congress against Alcoholism will be held at Antwerp under the presidency of Prof. Zunz of Brussels, on Aug. 20–25, when the following papers of scientific interest will be read: The alcohol question and social hygiene, by Sir Arthur Newsholme; the concentration of alcohol in the blood and the diagnosis of drunkenness from the medico-legal and insurance aspects, by Prof. Firket of Liège; recent experiments on alcohol and heredity, by Prof. Laitinen of Helsingfors; changes in the endocrine glands in the descendants of alcoholics, the endocrine glands and inebriety, the permeability of the meninges in alcoholics, and the excitability of the cerebral tissue in the descendants of alcoholics, by Dr. Puusep, Director of the Neurological Clinic at Tartu; results of American prohibition from the hygienic aspect, by Prof. Haven Emerson of New York; social effects of the Belgian Liquor Law of 1919, by Dr. Vervaeck, Director of the Institute of Criminal Anthropology at Brussels, and Dr. Meeus, Director of the Laboratory for Criminal Anthropology at Antwerp; alcoholism in Russia, by Dr. Dahlgren of Malmö; and alcohol and sport, by Drs. Bellin du Coteau and Bergeron of Paris. Further information can be obtained from the General Secretary, Prof. Charles Verlat, Rue Van Dyck 10, Antwerp.

THE Horniman Museum of the London County Council is planning its zoological exhibits on lines which might be adopted by other museums with advantage to the inquiring public and to the spread of fundamental scientific knowledge. A series of 29 cases has been set apart to illustrate the evidences and the theories of evolution from the zoologist's point of view. Specimens have been selected to show classification, structure, embryology, fossils, and domestication, all points of the great central truth of evolution, and the cumulative evidences brought together in this compact way could scarcely fail to impress a thoughtful observer. A "Handbook to the Cases illustrating the Evolution of Animals," by H. N. Milligan, has just been issued (London: F. S. King and Son, Ltd. 6*d.* net). It is a well-balanced compilation, written without scrappiness, suitable for reading in the museum in front of the cases, or by the fireside at home, and stating the case for evolution fairly and in reasonable detail. An appendix suggests books suitable for readers who wish to pursue the subject.

AN earthquake of considerable intensity was recorded at Kew Observatory on July 18 at 19 h. 17 min. 51 sec. G.M.T. The epicentre, which was at a distance of 5870 miles, appeared to hav [illegible] near that of the earthquake of April 9.

THE Russian Academy of Sciences has appointed

completion of forty years of scientific research by one of its members, Prof. P. Sushkin, the eminent zoologist. There will be a special meeting of the Academy in October, and it is hoped to publish a jubilee volume of papers.

THE Prince of Wales, who is a Trustee of the British Museum, has sent a donation to the British Museum East Africa Fund, which has been opened to enable the Trustees to continue the exploration of the deposits in East Africa containing fossil remains of large dinosaurs (see NATURE, July 21, p. 105). The scientific results of the exploration are likely to be of the greatest interest, and it is hoped that the Prince's example will stimulate a sufficient number of donors and so prevent the exploration being brought to a premature end.

THE Report of the Director-General of Public Health, New South Wales, for the year 1926 has recently been issued. In addition to vital statistics and administrative details, reports on scientific investigations carried out by officers of the Board are included. One of these deals with the ventilation of theatres, and certain standards are suggested; another gives a list of the species of fleas collected from rats and mice and their prevalence; and a third gives an account of paralysis which may follow the bite of a tick (*Ixodes holocyclus*).

NOTICE has been issued of the award in 1929 of the George Montefiore Foundation prize for an original work on electricity or its technical applications. This prize is awarded triennially by a jury of ten electrical [en]gineers, five of whom are Belgian and five foreigners, [un]der the auspices of the Association des Ingénieurs [él]ectriciens sortis de l'Institut électrotechnique Monte[fio]re. The prize for 1929 is 29,000 francs, and the [la]st date for the receipt of competing works is April [3]0, 1929. Particulars can be obtained from the [ge]neral secretary of the Association, rue Saint-Gilles, [31], Liège, Belgium.

THE *Bulletin of Hygiene* announces (vol. 3, p. 80; [19]28) that it has provisionally adopted the bacteriological nomenclature recommended by the American [So]ciety of Bacteriologists. This nomenclature is [bi]nomial and in accordance with botanical nomen[cl]ature, thus avoiding trinomial and polynomial [n]ames of species which have been hitherto commonly [u]sed by bacteriologists. Many new genera have also [b]een constituted, so that related organisms are [g]rouped together and separated from unrelated [fo]rms. Thus the term *Bacillus*, which formerly [in]cluded a very heterogeneous collection of straight [r]od-shaped organisms, becomes restricted to ærobic [s]poring forms only.

FROM the July number of *Evolution* we learn that [th]e fundamentalist campaign still continues unabated [in] certain of the States of U.S.A. In Arkansas the [qu]estion is to be submitted to popular vote at the [n]ext election, as must be done if eight per cent of [the] voters sign a petition so requesting. Already [m]ore than 20,000 signatures, nearly twice the number [r]equired by law, have been obtained to a proposal [fo]r "An Act to prohibit in any University, Normal, Public School, College or other educational institution in the State of Arkansas, that is supported in whole or in part from public funds, the teaching that man descended or ascended from a lower order of animals and providing a penalty for violation thereof." A curious way to put it, for an anti-evolutionist!

"NEWSLETTERS" continue to give supplementary information concerning the programme of the American Chemical Society's Institute of Chemistry, which is being held at Evanston, Illinois, on July 23–Aug. 18. The personnel is such as to inspire confidence that the audiences will be conducted with knowledge and discrimination over the extensive area selected for their mental excursions, and that the 'stories' which their guides have to tell will be well worth their attention. Names which catch the eye in glancing over the programmes are Dr. S. C. Lind on high energy in chemical reactions, Dr. W. P. Yant on chemical hazards, Dr. O. Kamm on the endocrine glands, Col. H. L. Gilchrist and Dr. W. L. Lewis on chemical defence, and Drs. C. A. Browne and H. G. Knight on agricultural chemistry.

THE appearance of the *Annual Report* for 1927 of the Council of the Yorkshire Philosophical Society offers an opportunity for commending the activities of this ancient institution, now in its one hundred and sixtieth year, to such as dwell in or are interested in the great county. The Council congratulates the members on a very successful year's working, but an analysis of the report suggests that the Society deserves more support than it is receiving. The membership, which now stands at 537, dropped by 32 during the year; and in spite of a welcome increase in gate money, indicating that greater use is being made of the Museum, and of a considerable reduction in expenditure on the grounds and Museum, there is a deficit on the year's working of £238, traceable to a decrease in the income derived from the Anderson bequest. A Million Shilling Fund has been opened with the view of enlarging the Museum and replacing old cases by modern bronze ones. In view of the expense likely to be involved in such a replacement, the Council may be interested to know that there seems to be a tendency in some of the large museums to revert to well-designed wooden casing.

MESSRS. Longmans and Co., Ltd., announce the early publication of the following books of science: "The Protamines and Histones," By the late Prof. A. Kossel. Translated by Dr. W. V. Thorpe (in Monographs on Biochemistry); "The Pressure Pulses in the Cardiovascular System," by Prof. C. J. Wiggers (in Monographs on Physiology); "The Principles of Applied Zoology," by Prof. R. A. Wardle; "Strain Energy Methods of Stress Analysis," by Prof. A. J. S. Pippard; "The Theory of Film Lubrication," by R. O. Boswall; and a new edition, revised by C. H. Rowe, of Salmon's "A Treatise of the Analytic Geometry of Three Dimensions." Vol. 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A highly qualified engineer with general works experience as

vice-principal of the Hyderabad State Technical Institute, India—The Wardle Engineering Co., Ltd., 8 Princes Street, Storey's Gate, S.W.1 (Aug. 1). A woman professor of physiology at the Lady Hardinge Medical College, Delhi—The Honorary Secretary, U.K. Branch Dufferin Fund, care of Major-General J. B. Smith, India Office, Whitehall, S.W.1 (Aug. 3). Two junior assistants in the Highways Department of the Manchester Corporation—The City Engineer, Town Hall, Manchester (Aug. 3). A lecturer in agricultural chemistry at the South-Eastern Agricultural College, Wye—The Secretary, South-Eastern Agricultural College, Wye, Kent (Aug. 4). An assistant for research in the Textile Industries Department of the University of Leeds—The Registrar, University, Leeds (Aug. 13). An assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Aug. 13). An assistant lecturer in the department of education of King's College, London—The Secretary, King's College, Strand, W.C.2 (Aug. 17). An assistant analyst in the Government Analyst's Department, Trinidad—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Aug. 20). An assistant in the Department of Physiology of London Hospital Medical College—The Dean, London Hospital Medical College, E.1 (Aug. 31). A professor of pathology in the University of Liverpool—The Registrar, University, Liverpool (Sept. 30). An engineer artificer for the Marine Department of the Government of the Gambia Colony—The Crown Agents for the Colonies, 4 Millbank, S.W.1, quoting M/839. A dietitian at St. Bartholomew's Hospital—The Clerk to the Governors, St. Bartholomew's Hospital, E.C.1. Lady graduate assistants at the Wool Research Association, Torridon, with knowledge (*a*) of economics, languages, or (*b*) physics or physical chemistry and languages—The Secretary, Wool Research Association, Torridon, Headingley, Leeds. Evening teachers of practical physics and chemistry for first-year students in the Engineering Department of the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. A full-time graduate assistant, with works experience, to teach mechanical engineering subjects in the Darlington Technical College—The Chief Education Officer, Education Office, Darlington.

Our Astronomical Column.

Recent Solar Activity.—Reference was made in Nature of July 21 to the recent increase of sunspots. Another big spot has since made its appearance, and this with two others may be included in a list of naked-eye spots observed this year.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
3	June 22–July 5	June 28·9	19° S.	1/1200
4	July 6–July 18	July 12·4	8° N.	1/700
5	July 12–July 23	July 17·5	18° S.	1/700

Areas are expressed as the proportion of sun's hemisphere covered.

Group No. 3 was a single spot for the greater part of its transit. No. 4 was a pair of spots of which the leader was the larger at first, but later the follower predominated. No. 5 was a stream composed of a large spot followed by a compact cluster of smaller spots. The group grew rapidly from a few spots near the sun's east limb on July 12. On July 17 the entire length of the stream was 15° of longitude, or more than 100,000 miles.

Photography of Faint Nebulosities.—The photography of faint nebulosities requires very great care if successful and trustworthy results, showing accurate detail uninfluenced by artificial nebulosities, are to be obtained. The technique of this work has been developed by Mr. F. E. Ross at the Yerkes Observatory, who is preparing a series of papers on the subject. The second paper of this series appears in the *Astrophysical Journal*, vol. 67, p. 281, in which the author describes his methods and the difficulties to be overcome. A 3-in. doublet of focal length 21 in. was used. Exposures of 2 hours reached the limiting magnitude for stars (15·4 mag.), beyond which it was not possible to obtain fainter stars by lengthening the exposure, though a definite gain in photographing nebulosities was obtainable. Earlier experimentors showed that it was possible to see more detail in original negatives than could be reproduced photographically, but improved methods of reproduction have now actually reversed this situation; it is interesting to find that Mr. Ross has been able to reproduce nebulosities (the genuineness of which was confirmed) which could not be detected on the original negative. These results have been obtained by making intermediate prints on panchromatic plates, using a red filter in order to increase contrast, the transfer processes being four in number. Some very fine illustrations of nebulosities in Monoceros, Taurus, and Perseus obtained in this way are given and discussed in detail.

Reports of the Cambridge Observatories. The reports of both the Cambridge observatories have recently appeared. That under Prof. Eddington has been engaged on photographic determination of the proper motions of faint stars from plates taken at intervals of about twenty years. Dr. Knox Shaw has undertaken the study of the colour indices of the stars with the large refractor at the Radcliffe observatory.

A photo-electric photometer is being used on the Sheepshanks equatorial, a sodium cell being found to give the best results; magnitude 5·5 is the faintest that can be studied satisfactorily. Prof. J. J. Nassau and Mr. R. O. Redman have been studying the relation between absolute magnitude and spectral type, attacking the problem in several independent ways.

In the Solar Physics Observatory special studies have been made of the spectra of ϵ Andromedæ, P. Cygni, and Nova Pictoris. A period of about 24·6 days has been found for the first named; this is about a quarter of the main period 96·67 days found by R. H. Baker at Allegheny. Dr. Carroll has made several theoretical investigations on stellar spectra.

With the spectro-heliograph a diminution of solar activity was noted in the second half of 1927; the diminution in the areas of calcium flocculi, and the decline in the mean latitude of the groups to 15°, are taken to imply that the maximum was passed in 1927. Mr. Butler has studied the laws of progressive changes in the forms of flocculi. The observatory sent an expedition to Aal, Norway, for the eclipse of June 29, 1927; but clouds prevented any results being obtained.

Research Items.

The Birthplace of Humanity.—Prof. Henry Fairfield Osborn returns to his attack against the generally accepted theory of man's ancestry, in a short article in *Science* (June 8, 1928, p. 570). Darwin thought that "our progenitors, no doubt, were arboreal in their habits, and frequented some warm, forest-clad land," and, as was pointed out in a recent leading article in our columns, this is the view still widely held. From considerations of a general kind, however, Osborn argues that a warm, forest-clad area was not the sort of place to stimulate the great progressive development which led to the human stock. Recent ethnographical and physiographical evidence indicates that intelligent progressive and self-adaptive types of mankind arise in elevated upland or semi-arid environments, where the struggle for food is intense and where reliance is made on the invention of implements as well as weapons. Again, the first modernisation of the entire mammalian kingdom, geology indicates, occurred in Oligocene times and was seemingly due to a wave of aridity concurrent with the complete elevation of great continental plateaux. This geological change caused a branching of the ways of mammalian evolution, for pre-existing mammals were compelled to choose between the warm, enervating, forest-clad regions, or the temperate, stimulating plateaux. Is it likely that the forerunners of mankind were exempt from this compelling and fateful decision? Is it not more likely that the stimulus seen in the development of so many mammalian groups was also that which gave the urge to the primate ancestors of man? If Osborn's speculation is right, he looks to the uplands of Mongolia or Tibet, the top of the world, as the most favourable geographical centres for such development, the final proof of which must rest upon the efforts of the fossil hunter and explorer.

The Dying God in Egypt.—Miss Murray has directed attention in Part 1 of *Ancient Egypt* for 1928 to passages in the Pyramid texts of Pepy and Merenra which appear to point to the sacrifice of the king as a fertility victim. Though the text is corrupt and the meaning of the religious ideas obscure, these passages seem to recite a demand of the people and the gods for the death of the king because he "has not eaten the Eye of Horus" and the "Limb of Osiris." The former expression usually means food. It is suggested that this may mean that if the king does not eat, perhaps owing to scarcity, he must die. The death, however, is ritual only, for he "lives on the bread of his father Atum" and his escape from death is compared with that of the god Setesh, this escape apparently being effected by ploughing the earth. The sacrifice takes place at a moon period, the new or the full, and presumably after a period of time, though the year is not given. Perhaps, as suggested by the tradition of Mykerinus, the length of his life was limited to seven years. The two lunar festivals of the month at new and full moon, it may be noted, were specially connected with the commemoration of the dead. The mention of the king as "a star opening the waters of heaven" would be a reference to his rain-making powers. The position of Setesh as the sacrificial victim whose example is to be followed by the king instead of, as usually, the principle of evil, may be due to the fact that Setesh was the god of the barren south. As the northern cult of Osiris advanced south, Setesh became the great enemy. The conflict of the Horus-people of the north and the people of the south was translated into the theory which made the son of Osiris the avenger against the murderer of his father, and the more noble Osiris became, the more evil was Setesh.

Seal Lice from Northern Regions.—Lieferung XI, XI*d*, of "Die Tierwelt der Nord- und Ostsee," contains an account of the body lice of the Pinnipedes by Ludwig Freund (*Anoplura Pinnipediorum*). It perhaps comes somewhat as a surprise to the uninitiated to find that such mammals as seals should harbour true lice, but these have been known for well over half a century, and they are here recorded from more than a dozen different species of seals. These lice belong exclusively to one family, the Echinophthiriidæ, and only three genera are known from the area described, with ten species. The *Antarctophthirinæ*, with five-jointed feelers, are provided with body scales, the *Echinophthiriinæ*, with four-jointed feelers, with specialised spines only. The function of these special scales and spines is to entangle air and so form an air sheath which surrounds the insects when under water. Those without scales occur chiefly on the head of the host and receive more air, whilst those with scales may occur on the body and survive a long immersion in water. Thus special respiratory facilities are provided for these marine lice. The author has illustrated his monograph with many careful original drawings in addition to those from other works. The original figures are chiefly of *Echinophthirius horridus*, which is common on several different seals, and has a wide range of distribution. The eggs of all those known are very firmly fixed to the hairs of the host.

Intestinal Flora of the Mole.—The microflora of the intestinal tract of the common mole, according to recent investigations of W. A. Kutejschikow (*Journal de biologie et de médecine expérimentales*, Moscow, **9**; 1928), is extremely poor, the stomach content being practically sterile; only a few organisms of the *Bacillus coli* type were isolated, and these proved to be closely allied to the similar organisms from man, but different from them serologically. This poverty of the intestinal flora is the more remarkable because the mole lives in the upper layers of soil, which are very rich in micro-organisms; it may be explained by the very rapid course of the digestive processes in the mole, and perhaps by some special properties of its gastric juice. The mole presents in this respect a marked contrast with the shrew, which has a very rich and varied intestinal microflora.

Control of the Peach-Borer by Paradichlorbenzine.—The peach-borer moth (*Ægeria exitiosa*) is widely spread in North America, where its larvæ burrow into the tree-trunks just below the surface of the soil. In addition to peach the insect also affects apricot, nectarine, and plum. The use of paradichlorbenzine is becoming increasingly favoured as a means of control ever since Blakeslee discovered its value in 1919. A great deal of experimental work has been carried out with reference to the application of this substance in different parts of the United States, and the most recent contribution to the subject will be found in *Technical Bulletin, U.S. Dept. of Agriculture* (No. 58, March 1928), by Messrs. O. I. Snapp and C. H. Alden. These workers report that paradichlorbenzine has been used on the same trees in one orchard for five consecutive years with no discernible tree injury and almost complete eradication of the borers. In the south it should not be used on trees less than four years old. Before applying it all grass, stones, and refuse are cleared away for a foot radius from the trunk, and ¾ oz. to 1 oz. of paradichlorbenzine crystals are distributed

in a continuous ring about 1½ inches from the trunk. The crystals are then covered with soil, which is packed around the tree to form a mound. An exposure of from four to six weeks was found to give excellent control, the borers having been killed by the gas given off.

WING DIMORPHISM IN WEEVILS.—The inheritance of long and short wings in the weevil, *Sitona hispidula*, is the subject of a study by Miss Dorothy J. Jackson (*Trans. Roy. Soc. Edin.*, vol. 55, part 3, No. 27). The two forms are carefully described and figured. In the form with short, truncate wings, the structure of the metanotum and metapleura is greatly altered, especially the parts serving for attachment of wing muscles. Some of the long-winged weevils differed from normal in having the wing muscles greatly reduced and modified, but in the brachypterous weevils these muscles were further reduced and difficult to find, their place being taken by body fat. Breeding experiments involving more than 600 weevils showed that the brachypterous type behaved as a simple Mendelian dominant to long wings. There were also indications that the short-winged type was more viable, perhaps owing to the presence of the reserve fat. Reduction in the wing muscles was unaccompanied by any change in the muscles that lift the elytra. Both forms of the weevil are found to be common in Europe, where the two forms frequently occur together; but hitherto only the long-winged type has been found in America. Evidence from breeding indicates that the abnormal condition of the wing muscles in long-winged weevils is inherited, probably as a Mendelian recessive. Interbreeding occurs between the long- and short-winged types, and about half of the wild short-winged insects were found to be heterozygous. Of 34 species of *Sitona* examined, ten were found to show wing dimorphism, and this number will probably be increased. In 12 species only long wings were found, and in 12 others only short wings. Other families of Coleoptera frequently contain species in which the wings are reduced or absent, and wing dimorphism is recorded in several. The origin of the wingless condition in flying insects is discussed, and it is pointed out that the facts in *Sitona* are not in accord with any theory of disuse. The conclusion is drawn that wing reduction has arisen through abrupt mutations, and is a very ancient phenomenon in Coleoptera. It may form the basis of selection under certain conditions, but since apterous species occur in the most diverse situations, the flightless condition is probably in many cases of little importance in determining the survival of a species.

ANTARCTIC PLANT LIFE.—Some interesting facts regarding Antarctic and sub-Antarctic vegetation are recorded by R. N. Rudmose Brown, the polar geographer and naturalist ("Problems of Polar Research," *Amer. Geog. Soc.*, Special Publ. No. 7). Antarctic plant life is necessarily confined to the edges of the Continent, the mountain ranges, and islands near the coast. The great ice sheet is completely devoid of any form of life. The poverty of the flora compared with that of the same latitudes in the North Polar regions is striking. The Arctic regions support some four hundred species of flowering plants as against only two species in the Antarctic. This may be ascribed to the shortness of the Antarctic summer and the remarkably low temperatures, for no month has a mean temperature above freezing point. As a rule, December is well advanced before the rays of the sun lay bare what little soil occurs in a few places. Only for a month or six weeks is the vegetation, except lichens on cliff faces, exposed to sunlight. The ground thaws to a depth of only a few inches on a few cloudless days, and even then is saturated with ice-cold water in which root hairs are physiologically inactive. Mosses are numerous, and form one of the chief constituents of the vegetation, and more than fifty species have been recorded, mostly from Graham Land. Fruiting specimens are rare, and only six species have been found showing this mode of reproduction. About seventy species of freshwater algæ have been found in the South Orkneys, the most interesting being species of *Sphærella*, which colours snow red. Marine algæ are very abundant in Antarctic Seas, and grow at times in pools which are frozen solid all winter. Luxuriant genera like *Laminaria* and *Macrocystis* flourish only on sub-Antarctic coasts which remain open throughout the year. Most remarkable of all, however, is the wealth of diatom life, in strong contrast to its scarcity in warm seas. The important factors operating in this case are probably decreased activity of denitrifying bacteria at low temperatures, the tendency for the surface layers of water to sink and be replaced by deeper layers richer in nitrates, and the abundance of silica in polar seas owing to the low temperature of the water and the great quantities of glacier-swept debris from the land.

PERMIAN FOSSIL INSECTS OF NORTHERN RUSSIA.—Mr. A. V. Martynov has published some very interesting results of his extensive studies on the fossil insects found in several localities in northern European Russia in the Permian strata (*Travaux du Musée Géologique près l'Académie des Sciences*, Leningrad, vol. 4; 1928). A very large number of new species, genera, and some new families are described in the paper (written in English), and fully illustrated on the 19 plates. An analysis of the fauna found shows that the greater portion of the Permian fauna of northern Russia, about three-fourths of the species, was not related either to the Carboniferous or to the Permian faunas of western Europe; about one-half of these species showed some more or less definite relations to the Lower Permian fauna of Kansas and partly also to the Upper Permian fauna of Australia. The forms of the 'Kansas type' are all characterised by their rather small dimensions, while the Permian forms of Europe are mostly large; this suggests that the fauna of the 'Kansas type' developed under less favourable climatic conditions than the European fauna of the same period, probably in some land north or north-west from Kansas during the Lower Permian period; then it migrated by the North Pacific bridge to the Angara continent and penetrated farther westwards, reaching European Russia in the Upper Permian period. A meridional sea which extended at that time right across the present European Russia from north to south, stopped the fauna from reaching western Europe, where a distinct Permian fauna consisting of large forms developed under very different and more favourable climatic conditions. Certain affinities between the Permian faunas of northern Russia and of Australia are difficult to explain in the present state of our knowledge.

EARTH-TILTINGS PRECEDING EARTHQUAKES.—Two interesting papers on this subject are published in the *Proceedings* of the Imperial Academy, Tokyo (vol. 4, pp. 148-153). Mr. S. Haeno has examined the records of two horizontal pendulums at Tokyo specially designed for the purpose. He notices the existence of two regular variations, one diurnal, the locus of the vector end being an elliptic curve with a major axis of 0·57″ in the direction N. 80° W.; the other annual, the locus of the vector end being roughly elliptical, with a major axis of 10″ in the direction N. 50° E. These regular variations agree

closely with variations of the earth's temperature at a depth of 10 cm. In addition, the records sometimes indicate variations of an irregular type, one of which occurred just before the Haneda earthquake of Aug. 3, 1926. In the other paper, Prof. A. Imamura describes the tilting of the earth for forty days before the great earthquake of Sept. 1, 1923. From July 18 until July 30 the tilting southwestwards may be regarded as a normal variation of land-level caused by the gradual increase of air temperature. Then came a very conspicuous and abnormal tilting of nearly 1·7″ downwards towards W. by N., which continued until Aug. 17. During the succeeding fortnight the changes were normal until the morning of Sept. 1, when a sharp tilting of 0·3″ occurred in eight hours, ended abruptly by the great shock.

NATURAL GAS–AIR EXPLOSIONS.—Since for testing purposes, and for the study of gas explosions on a large scale, British investigators use methane, whilst in the United States of America natural gas—a mixture of the simpler hydrocarbons, and variable in its composition—is employed, a comparison of the two methods became desirable. The work, which was carried out at Pittsburgh under a scheme of co-operation between the Safety in Mines Research Board of Great Britain and the Bureau of Mines, U.S.A., is described in *Technical Paper of the U.S. Bureau of Mines*, No. 427, by H. F. Coward and H. P. Greenwald. The results amply confirm provisional conclusions that the use of natural gas (composed of paraffin hydrocarbons with not more than 2 or 3 per cent of nitrogen) instead of methane for testing the safety underground of electrical equipment, flame lamps, and explosives is justified, any slight difference being, in fact, on the safe side. The lower limit of inflammability of a natural gas in air may be calculated almost exactly, and the higher limit approximately, m the limits of its constituent hydrocarbons. un the results of a combustion analysis giving the io between the contraction on explosion and the lume of carbon dioxide thereby formed, and erence to a curve, the lower limit may be found th equal accuracy in the absence of knowledge of exact composition of the natural gas. It is eresting to find that the speed of uniform movement flame, that is, the initial stage in the propagation flame from the open end of a tube towards the sed end, can be calculated for mixtures of various mples of natural gas and air from data for the lividual hydrocarbons on the basis of the so-called law of flame speeds." Many of the experiments re carried out with a tube 100 ft. long and 12 in. diameter, in order that the conditions should ap- oach those obtaining in industry.

A NEW PERIODIC TABLE.—Prof. Yamamoto, of the yoto University Observatory, has recently revised form of periodic table of the elements which he first ed in January 1927 in a Japanese journal of stronomy entitled *The Heavens*. In this table the ements are arranged in families and series in much e usual way, but fall into two main groups. One of ese groups contains elements almost all of which o not appear to be present in the stars or in the sun, hile the other includes most of the elements so far ved in stellar spectra.

THE REACTION BETWEEN METHANE AND STEAM.—The reaction: $CH_4 + 2H_2O \rightleftharpoons CO_2 + 4H_2$ has been in- estigated at 500° C. and 1 atm. pressure by R. N. eas d P. R. Chesebro, who describe their results in he May issue of the *Journal of the American Chemical Society*. The equilibrium was approached from both ides, the gas mixtures being passed at measured rates f flow over a supported nickel-thoria catalyst at 505° C. and then analysed. The average value of the equilibrium constant at this temperature was found to be 0·037, while that calculated from the free energy equations of Lewis and Randall is 0·0387, thus showing that the expression used for the free energy of methane at 500° C. is satisfactory. The presence of about 1 per cent of carbon monoxide in the effluent gas indicates that the reactions $CH_4 + H_2O \rightleftharpoons CO + 3H_2$ and $CO_2 + H_2 \rightleftharpoons CO + H_2O$ also take place to some extent. The reactions between methane and steam at high temperatures form a possible source of hydrogen and hydrogen–carbon monoxide mixtures, the concentration of the carbon monoxide being decreased if required by the use of excess of steam.

PURIFICATION OF INVERTASE.—The problem of obtaining a pure preparation of the enzyme invertase has been partially solved by some recent work of Sastri and Norris (*Jour. of Indian Inst. of Science*, vol. 2A, Part 1). Several methods in use for the purification of invertase have not so far succeeded in producing the enzyme free from both protein and yeast gum. The most difficult part of the problem, however, is the removal of substances closely allied to the enzyme itself, and probably consisting of inactivated enzymes, zymogens, and decomposition products of invertase. The method of Sastri and Norris consists essentially in the autolysis of the yeast in the presence of toluene, after which the liquor is concentrated by freezing. Various impurities are then absorbed by kaolin, which is centrifuged out and the clear liquor siphoned off. The enzyme is then precipitated by ammonium sulphate (which does not inactivate the invertase), and the precipitate is washed with water. Removal of the sulphate by dialysis follows, and the enzyme is absorbed by aluminium hydroxide, which is later filtered off by a bed of previously ignited kieselguhr. The preparation is white and free from yeast gum. It is odourless and gives neither the Molisch test for carbohydrates nor the Millon test for proteins. It gives, however, a very faint biuret reaction and the xanthoprotein reaction. The nitrogen content and ash content are both very low. It is free from maltase, oxidase, reductase, and all other enzymes known to be contained in yeast. The activity of the preparation is expressed by the 'time value' defined by Willstätter and Kuhn, and changes during the process of purification from ± 0° = 430 minutes in the original yeast liquor to ± 0° = 0·91 minutes in the purified enzyme.

THE CARBONISATION PROCESS.—The eighteenth Report of the Joint Research Committee of the Institution of Gas Engineers and the University of Leeds records a continuation of the study of the carbonisation process carried out in the Corbet Woodall Experimental Plant at the University of Leeds. It deals with the effect of size of coal treated and with the effect of admixture of ferric oxide (2·2 per cent), calcium carbonate (3·4 per cent), sodium carbonate (3·3 per cent), with the Nottinghamshire coal distilled. The retorting temperature was reduced to 915° C., and the results were largely parallel with those obtained in previous tests at 980°. Experiments with blends of coal and coke did not promise great advantage. Striking effects were observed with the mixtures of coal and inorganic compounds. The yield of gas in therms was always increased—with the soda by 12 per cent—and this was ascribed partly to the more far-reaching decomposition of steam by the reactive coke. It was only the mixture with calcium carbonate which gave a much greater yield of ammonia. The reactivities of the cokes were increased by the presence of the inorganic compounds, but abnormalities require further investigation.

The Forest Research Institute, Dehra Dun, India.

By ALEX. RODGER, Inspector-General of Forests, India.

THE history of forest research and education in forestry in India has been intimately connected with Dehra Dun for the last fifty years, as the first college for training Indians in forestry was started there in the year 1878. Dehra Dun was chosen because of its favourable position for the study of two important types of Indian forests, those where Sal (*Shorea robusta*) predominates, and the coniferous forests of the Himalayas, which are all well represented close to Dehra Dun, and also because of its delightful situation and (during most of the year) its favourable climate.

About twenty-five years ago it was realised that the proper conservation, development, and utilisation of the magnificent State forests in India (covering 250,000 square miles, or 23 per cent of the total area of the country) depended on organised research, and a start was made in a small way by the appointment of a forest zoologist, who began work on insect pests in 1900. The outlook on research of professional forest officers has changed very much since that day. It is recorded that an officer high up in the department was indignant because the first research officer had produced no literature within a year after his appointment. Public opinion rapidly matured, and about twenty years ago four other research officers were appointed. It was considered at that time that the conduct of research in forestry in India should be divided into five branches, covering sylviculture, economy, botany, entomology, and chemistry, and this arrangement has lasted to the present day.

Including the area under forest in Indian States, about one quarter of the Indian Empire is covered with forest, and the net revenue in British India in the year 1925–26 was two million pounds, gross receipts amounting to 4½ million pounds and expenditure to 2¼ million. The surplus has more than doubled during the last twenty years. It will be recognised that considerable expenditure on research in forestry, calculated to improve the methods of growing, developing, and exploiting the forests, was justified.

The first buildings used for research were, as usually happens in such cases, small places, situated wherever anything suitable could be obtained. In 1913, however, a proper building was constructed, containing laboratories, offices, and museums for the sylviculturist, economist, and entomologist. The botanist and chemist were housed in separate buildings on the same estate. This was the first attempt to concentrate forest research in proper buildings, and it was soon realised how useful the concentration was. With modern development of forestry in the field, work increased rapidly, and in 1920 much more ambitious plans were drawn up. These comprised a large building with workshops, electric plant, stores, insectary, and residences of different grades, all situated on an estate of 1200 acres which was acquired close to Dehra Dun. The main building (Fig. 1) will be completed in 1928. In this fine building there is ample accommodation for the five branches, and possibly part of the Forest College will also occupy it. The new building contains six museums, with floor space of 26,000 square feet, a convocation hall with 6000 square feet, and numerous laboratories and offices, which have a floor space of about 63,000 square feet. The architect is Mr. C. G. Blomfield, of Delhi.

FIG. 1.—Main building of the Forest Research Institute, Dehra Dun, with the Himalayas in the background.

The aim of the staff of the Forest Research Institute is to find out and publish everything about the forests and forest products of India which will be of use to the public and to the forest departments of the various provinces and of the Indian States. Information when collected is published at once and is available to any one, and no small part of the time of the controlling staff is taken up in answering inquiries from every conceivable source. Most of these inquiries come, of course, from India, but there is

sely any part of the world with which the staff is in communication, and inquiries are regularly ived from almost every country where forestry forest products are of any importance.

ıe cost of the Forest Research Institute is entirely by the Government of India, the annual expendi- being about £70,000. The total capital cost of the Forest Research Institute, which is not yet quite pleted, will be about £750,000, surely a record for st research. The majority of the controlling staff omposed of forest officers deputed from their 'inces, but there is a number of specialists who with subjects such as timber testing and kiln oning. The total staff of the Forest Research itute and College comprises 35 controlling and subordinate members. The Institute is constantly ed by forest officers and others from every part he world, and some of those visitors stay for a iderable period, and take a course in one or more he special lines dealt with.

work done by the various ıches is of course closely ed, and constant consulta- s take place between the ıch officers, but it will be con- ent to describe the scope of work done under the various ls.

SYLVICULTURE.

his, although not the largest, e senior branch, as is proper a Forest Research Institute. f. Troup, who is now Director he Imperial Forestry Institute Oxford, was the pioneer in lern scientific sylviculture in ia, and he embodied the results his observations in his three volumes "The Sylviculture dian Trees," published by the rendon Press in 1921. Since f. Troup left Dehra Dun the nch has developed consider- y, and the work of the Im- ial sylviculturist is co-ordin- d with that of a number of vincial sylviculturists in Ma- s, Burma, Bengal, etc. Sample ots to determine the best thod of growing important cies, and to obtain figures for volume, incre- nt, etc., have been established in many forests roughout India and Burma, and the working up the statistical data obtained from all these sample ots is undertaken at Dehra Dun. Yield and volume bles for important species are regularly published, d a great deal of work is done on the germination d development of the seeds of forest trees. Working ans are examined for provinces, and all sylvicultural atters constantly discussed with local officers.

Model plantations of several important species are ing made on the estate at Dehra Dun close to the orest Research Institute, partly with the view of aking them into demonstration areas for the students the College, which is under the same president as e Forest Research Institute. The sylviculturist can ly, of course, show such immediate results as the orest economist, but, with the present rapid additions o our knowledge of how to treat the forests of India, he value of the forests as a great asset of the country increase steadily. Sustained scientific manage- ent in the case of valuable property which does not ome to maturity for 100 or 150 years is, of course, f the utmost importance.

ECONOMY.

Forest economy or utilisation has developed at the Forest Research Institute more than any other branch, and has in fact been divided already into sections, covering wood technology, timber testing, wood preservation, kiln seasoning, paper pulp, minor forest products, and wood working. The workshops for this branch are separate from the main building and were constructed before it. This branch is in intimate relation with the most important users of timber and forest products, for example, the railways and the Gun Carriage Factory, and is continually giving advice to these and to other commercial and semi-commercial concerns. To ensure continuity of experimental work, a triennial programme is passed by the Inspector-General of Forests and the different inquiries are carried on under the provisions of printed projects in which the lines of research are laid down.

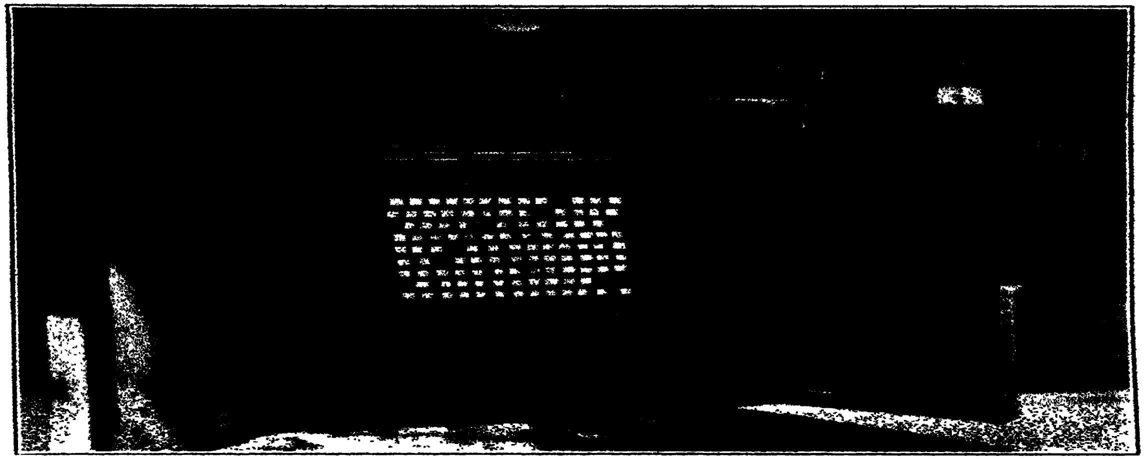

FIG. 2.—Experimental Sturtevant kiln at the Forest Research Institute, Dehra Dun, showing timber stacked ready for seasoning.

In the Timber Testing Section more than 200,000 tests have been carried out during the last five years, and a great quantity of valuable data about all the more important Indian timbers has been collected. As examples of the results of tests made in the laboratories, the life of aeroplane wing spars in India was extended from five to seven years, and it is expected that local wood will be used on a large scale in the oil wells of Burma in place of the expensive imported hickory.

In a climate like that of India nothing can be more important for users of timber than to see that their wood is properly treated before it is made up. Experimental seasoning kilns have now been running for some years at Dehra Dun, and the best method of seasoning many important Indian timbers has been ascertained. As a result of the work done at Dehra Dun, the Gun Carriage and Rifle Factories and the Railway Board are installing batteries of kilns. The Forest Research Institute carried out most successfully seasoning operations on 1000 walnut rifle parts, seasoning them all in seven weeks instead of five years. Timber endures so many hardships in the fierce climate of India between the forest and the factory,

that proper seasoning is of the utmost importance, and this is now being realised by timber users.

The most important work done in the Wood Preservation Section is in connexion with railway sleepers. It might appear that India would have no difficulty about the supply of railway sleepers, but this is far from being the case, and the supply of durable woods (such as deodar and teak) which resist white ants is insufficient. The Forest Research Institute has concentrated on treating sleepers of second class woods in such a way that they can be economically used to take the place of the more durable timbers. Success has been obtained, and several railways have built, or are building, plants to undertake the treatment of the cheaper Indian timbers. This will result in the profitable utilisation of millions of tons of second class woods, which would not otherwise find a market for years to come.

Bamboos cover very large areas in the Indian forests, and the Forest Research Institute has done a great deal of work to prove that they can be profitably utilised in the form of paper pulp. Difficulties in digestion have been overcome through the skilled investigations of Mr. Raitt, who has also examined and reported on pulp propositions in the forest. As soon as the price of wood pulp rises, due to the exhaustion of supplies, bamboo will come into its own. It is believed that it may be found possible to use it for making artificial silk, and samples have been sent to England for trial.

The basis of all proper utilisation of timber is a knowledge of its structure, and this is especially the case in India, where there are so many different hard woods. Dr. Brown, of the University of Syracuse, U.S.A., was employed by the Government of India for a short period, and laid the foundations of the scientific study of the microscopical structure of Indian timbers. He published a "Manual of Indian Wood Technology" and is now training an Indian at Syracuse for the Institute. The Institute receives numerous specimens of wood with the request that they may be identified, and this can only be done by highly trained wood technologist.

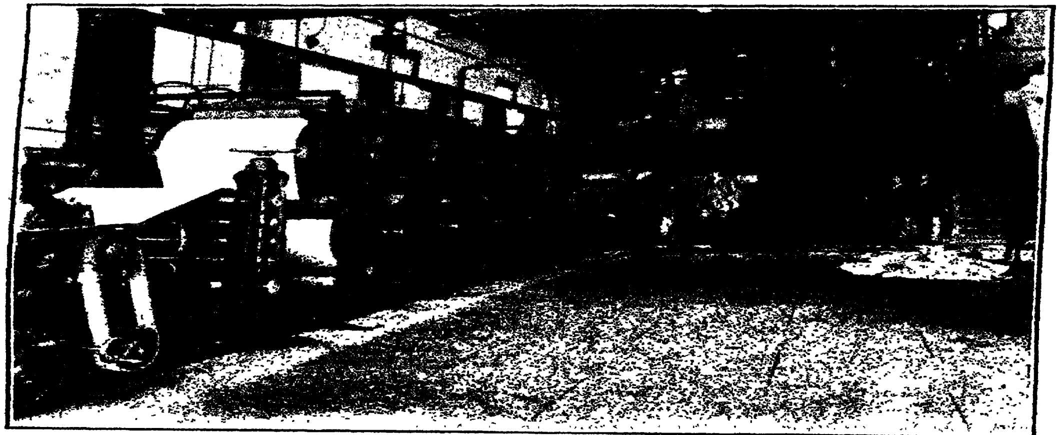

FIG. 3.—Paper pulp experimental machine at the Forest Research Institute, Dehra Dun.

The Wood-Working Section is a most important part of the economic branch. It receives large quantities of timber from all over India and Burma, and converts them to the sizes required for experimental work in all the other sections. In the section itself all the most important woods of India and Burma are used for carpentry, veneering, plywood, etc., and the volume of work in the section increases daily. Indian carpenters are being trained in large numbers in modern methods of wood-working. A modern sawmill deals with the logs, and a fully equipped machine-shop handles the output from the sawmill.

In considering the total export trade of India in forest products, it may be noted that the value of minor products exported considerably exceeds that of timber. The value of lac exported annually runs into millions of pounds. The section of the Forest Research Institute which deals with these products has never been properly manned or equipped, and it is only now that properly organised investigation into many important products is being undertaken. The large majority of forest species yield something of use to man, and in Burma alone, where there are some 3000 woody plants, there is an immense field for investigation. Skilled modern treatment of the resin of one of the Indian pines in the Punjab and the United Provinces has already resulted in India becoming largely self-supporting in the matter of turpentine. Among other forest products which offer profitable fields for scientific inquiry are gums, oils, cutch, fibres, tanning and dyeing materials, charcoal, drugs, spices, and fodder plants.

FOREST BOTANY.

Systematic work and mycology take up most of the time of the officers of this branch. The mycologist has only just been appointed, but already good progress has been made in investigating an important fungus on conifers. The preparation of floras and the management of the new arboretum come under this branch, and an important part of the work of the botanists is the determination of species. A surprising amount of incorrect information regarding the identity of plants is received from forest tracts.

FOREST ENTOMOLOGY.

This, the first of the branches of the Forest Research Institute to be founded, is now a large and flourishing concern. The laboratories and insectary at the new Institute are spacious and up-to-date, and the collections are splendidly housed.

One of the most important subjects to which the officers of this branch have devoted themselves is the enormous damage done to the valuable Sal (*Shorea robusta*) forests of Central and Northern India by a beetle, and the measures devised for checking the damage have been most successful.

Systematic entomology plays an important part in all investigations. Defoliators and other pests attacking teak are under investigation, and all the more important species in India come under the consideration of the entomologists. The intimate

connexion between science and profitable forestry is never lost sight of. Many minor pests are being studied, and help is given to all provinces in solving their problems.

CHEMISTRY.

This is the smallest branch of the Forest Research Institute and its work is chiefly complementary to that of the others. It will be sufficient as an example to refer to the description of work on minor forest products given above, and it is easy to realise how important a part chemistry must play in the examination of the problems they provide. The study of forest soils is carried on in association with the sylviculturist, and the analysis of mixtures used for preserving wood is another example of the activities of the branch.

EDUCATION.

All the research officers take part in the instruction of the students at the Forest College as an important part of their duties. This applies not only to the members of the staff who specialise in entomology, botany, etc., but also to the experts in timber testing, wood-working, paper pulp, seasoning and wood preservation.

PUBLICATIONS.

The results of the work done at the Forest Research Institute are published by the Government Press as soon as possible. Some 200 *Records*, *Bulletins*, etc., have appeared since 1905, as well as many manuals, floras, and volumes on other aspects of forestry.

International Astronomical Union.

LEYDEN MEETING.

THE third ordinary general assembly of the International Astronomical Union was held at Leyden on July 5–13. It was by far the most representative meeting so far held, astronomers of twenty-eight different countries being present. Incidentally, it was the largest gathering of astronomers ever held. During the meeting the adhesion of Rumania to the International Research Council and to the Astronomical Union was announced, increasing the total number of members to twenty-four. The close of the meeting left a very general hopefulness that before the next meeting of the Union most of the seven nations present as visitors for the first time (Germany, Austria, Hungary, Russia, China, Esthonia, Lithuania) would have become members of the Union.

The meeting opened with a reception by the Dutch government at the beautiful old Ridderzaal in The Hague. Addresses were delivered by His Excellency the Minister of Education, Arts and Sciences, the president of the Royal Academy of Sciences at Amsterdam, the Rector Magnificus of the University of Leyden, and the president of the International Astronomical Union (Prof. W. de Sitter, Director of the Leyden Observatory). The keynote of these addresses was one of gratification that under the auspices of neutral Holland the countries separated by the War had found it possible to come together again in the pursuit of science and the study of astronomy. Throughout the meeting, abundant hospitality was organised by the local committee, of which the efficient and active secretary was Dr. C. H. Hins, of the Leyden Observatory. Here we need only mention a trip to the Lake District near Haarlem, a most interesting tour round the reclaiming works by which within a generation the Zuider Zee is to be reclaimed and large stretches of country lost seven hundred years ago to be once more made fertile; a visit to the Frans Hals Museum at Haarlem, and various receptions and garden parties. Honorary degrees were conferred by the University of Leyden upon M. H. Deslandres, Director of the Paris-Meudon Observatories, and upon Dr. Küstner, late director of the Bonn Observatory. The latter was, unfortunately, prevented by ill-health from attending the meeting, and Dr. Guthnick acted as his proxy.

The main work of the Union was performed at the sessions of twenty-eight commissions. A few of the resolutions of general interest brought forward by the commissions and adopted by the Union may be referred to here. It was agreed to publish, with the help of Prof. Stroobant (Uccle), a list of observatories and astronomical staffs, and with the help of M. Delporte an atlas on a small scale with a list of arcs definitely fixing by hour circles and parallels of latitude the boundaries of the constellations. It was agreed to advise astronomers for the present not to use the term G.M.T. (Greenwich Mean Time), which changed its significance on Jan. 1, 1925, but to use for time reckoned from Greenwich Mean Midnight the term G.C.T. (Greenwich Civil Time), W.Z. (Weltzeit), or U.T. (Universal Time). The expression G.M.A.T. (Greenwich Mean Astronomical Time) should be used by anyone reckoning time from Greenwich mean noon.

The report of the Commission on Dynamical Astronomy contained an interesting statement by Prof. de Sitter of the terms required to convert Newtonian or uniform time to astronomical time given by the variable rotation of the earth. The Commission on Solar Physics, collaborating with a commission of the International Research Council on solar and terrestrial relationships, agreed on an index of solar activity. It was also agreed to urge on the Dutch government the need of observing the total eclipse of May 9, 1929, visible in Sumatra, and on the Australian government the need of observing that eclipse and the eclipse of Oct. 22, 1930, visible in the island of Niuafou, in the Tonga protectorate. Further useful co-operation between eclipse observers of different countries was arranged, and a further study of the distribution of the continuous spectrum of the sun in the ultra-violet was urged. The growing importance of line spectrophotometry in the study of the sun's atmosphere was also recognised.

The Committee on Wave Lengths, for which Dr. Babcock had prepared a very valuable report, recommended a number of secondary standards of iron lines, and also a table of standards of solar wave-lengths. Both of these were adopted by the Union. The most important problems in wave-length determination were also scheduled for immediate attention. The Commission on the Physical Observations of Planets urged further work on the absorption bands in planetary spectra and undertook to compile a catalogue for the names of Martian markings. The Commission on Lunar Nomenclature is nearing the end of its work of compiling a definitive catalogue of the markings on the moon. The Commission on Longitude Determination by Wireless reported that it would repeat the experiments of October 1926 about the year 1933, when the lessons of the previous experiments have been fully studied and steps taken to determine and eliminate systematic errors revealed in the previous work. The Committee on Variation of Latitude reported that a new latitude station in latitude 39° N. would shortly be established at Kitab, near Samarkand, under the Uzbekistan-Soviet

Government, with Prof. Nefedjew of Perm in charge; also work was to be started at Lembang in Java, near the equator, and there was a hope that observations might soon be commenced at Adelaide and La Plata, two southern stations in the same latitude, and with a longitude difference of nearly 12 hours.

The Commission on Shooting Stars decided to compile a new catalogue of radiants of meteor showers and to develop the photographic study of meteors. The Commission on the Carte du Ciel reported that the completion of the work was in sight, and the financial support of the Union was considerably increased with the view of hastening its completion. The reports of the Commissions on Stellar Parallaxes and Photometry showed plenty of important work done and in hand, but proposed no serious changes in present work. The Commissions on Double Stars and Radial Velocities were concerned in selecting lists of stars for co-operative or special observation. The Commission on Variable Stars secured several small grants for catalogues and for the publication of observations, and asked for more systematic observations of the spectra of variable stars. The Commission on Nebulæ and Stellar Clusters adumbrated several important schemes to complete the survey of the heavens before starting a fresh catalogue and scheme of classification; also it is examining how to secure accurate positions of nebulæ, to serve as a background against which a rotation of the galaxy might be shown.

The Commission on Stellar Classification, in order to widen the scope of its activities and to apply many physical criteria which modern spectral analysis and spectrophotometry are rendering of importance, has changed its name to the Commission on Stellar Spectra. The Commission on the Bureau de l'Heure asked for an increased grant, which led to a motion being put to the general assembly by the executive committee expressing the hope that some reorganisation of the Bureau would be possible and that after 1931, the end of the present convention, the Union might be relieved of the present charge upon its income involved in maintaining the Bureau de l'Heure.

The Commission on Stellar Statistics is undertaking the execution of tables of conversion of equatorial co-ordinates and proper motions into galactic ones. Finally, the Commission on the Solar Parallax has arranged for the necessary observations, including photometric and spectroscopic ones, to be made in connexion with the approaching conjunction of Eros. Fresh commissions have been appointed to act until the next general assembly; the commission on solar rotation has been absorbed into that on solar physics, and a new commission on stellar constitution, with Prof. Eddington as chairman, has been appointed.

The next meeting of the Union is, on the invitation of the American delegates, to be held early in September 1932, in the eastern United States. The date and place are chosen partly to fit in with a total eclipse of the sun through Canada and the eastern United States on Aug. 31, 1932. As the present convention ends in 1931, there will have to be an intermediate extraordinary assembly of the Union between now and then. The new executive is charged with the tasks of appointing a committee to revise the present statutes, of modifying the present practice limiting membership of the Union to members of various commissions, of preparing fresh regulations for the Bureau de l'Heure, and of securing a new lease of life for the Union after 1931. The new executive committee consists of Sir Frank Dyson (president), Prof. Schlesinger, Prof. Abetti, Prof. Andoyer, Prof. Norlund, and Prof. Nušl (vice-presidents), and Lieut.-Col. Stratton (general secretary).

The final meeting of the general assembly closed with thanks to the Union's hosts, and especially to Prof. de Sitter, who combined the double task of chief host and president at this most successful meeting, and has ruled over the Union through a difficult period of its life.

The Carbon-Nitrogen Ratio in Wheat.

SINCE the publication in 1918 of Kraus and Kraybill's fundamental work on the vegetation and reproduction of the tomato, the carbon-nitrogen ratio has been recognised as a factor of prime importance in the growth and reproduction of the plant. Recently some careful work by Phyllis A. Hicks on the carbon-nitrogen ratio in wheat has confirmed and somewhat extended the conclusions of the two American workers referred to above (*New Phytologist*, vol. 27, No. 1).

It is pointed out that the primary value of the relation lies in the fact that the growth of the plant is dependent on the balance between the metabolic processes of carbon assimilation and respiration on one hand, and nitrogen assimilation on the other. In the present work, pure lines of three strains of wheat were used, two spring and one winter variety, and the carbon-nitrogen ratios were determined at close intervals in the life-histories of the plants by microchemical analysis. 'Carbon' is taken as embracing all forms of carbon in the plant, and 'nitrogen' all forms of nitrogen.

It was found that a low carbon, medium nitrogen, and low carbon-nitrogen ratio encourages vegetative growth. Vegetative activity reduces nitrogen percentage steadily, but the carbon rises to a maximum about half-way through the life-history and again falls considerably before blooming. This is taken to explain the double carbon maxima for apple spur results, since carbon maxima in themselves have nothing to do with flower formation. The carbon-nitrogen ratio rises steadily throughout the vegetation period, and when a sufficiently high ratio obtains, flowering occurs. Strong support is given to the contention of Kraus and Kraybill that fruitfulness is associated neither with highest nitrates nor with highest carbohydrates, but with a condition of balance between them.

Every cultural strain has its own distinctive carbon-nitrogen ratio, at which flowering occurs, but in every case it represents the maximum of the ascending ratio curve. In this relation an interesting difference between the spring and winter strains of wheat is noted. A ratio of 14-17 covers the range of conditions favourable for flowering in both spring varieties, whereas a ratio of 31 is required for the winter variety. This agrees with the conclusions of Hedlund, that varieties of wheat with a higher percentage dry weight are more winter hardy; and the higher percentage dry weight is due to high carbon content, which compensates for the longer seedling life under winter conditions. Senescence is accompanied by a high carbon-nitrogen ratio, and senescent changes can be prevented at the expense of flowering by controlling nitrogen content. It is suggested that it may be possible to apply nitrogen to annual plants in such proportions and at such periods as would first of all allow of flower and seed production, and then prevent senescence of the tissues or induce rejuvenescence.

University and Educational Intelligence.

EDINBURGH.—At the meeting of the University Court on July 16 a letter was received from the Distillers' Company, Ltd., stating that the Company is impressed by the good work which the Technical Chemistry Department of the University is doing "in fitting trained chemists to take part in British industry by giving them a knowledge of engineering and familiarity with plant used in technical operations." The Company is therefore prepared to become financially responsible for a studentship in the University carrying cash payments at the rate of £100 per annum to the recipient, and such University fees as may be necessary. The studentship would be awarded to a candidate who has completed his course in chemistry and is willing to devote a further year to study in the Technical Chemistry Department.

The Company is willing to find a position for the selected student for a year on trial in its organisation at a salary commencing at not less than £250 per annum. The Court gratefully accepted the offer and resolved to institute the studentship.

LEEDS.—Mr. W. T. Astbury has been appointed to the lectureship in textile physics, one of the posts instituted under the new scheme of research in the Clothworkers' Departments.

LONDON.—Prof. John Macmurray has been appointed as from Aug. 1 to the Grote chair of philosophy of mind and logic tenable at University College. Mr. Macmurray was in 1919–20 lecturer in philosophy in the University of Manchester, and in 1920–22 professor of philosophy at University College, Johannesburg. Since 1922 he has been fellow, classical tutor, and Jowett lecturer in philosophy at Balliol College, Oxford. He is the author, with C. R. Morris, of "The History of Philosophy in Europe since Hegel" (in the press).

Dr. Robert Donaldson has been appointed as from Aug. 1 to the Sir William Dunn chair of pathology tenable at Guy's Hospital Medical School. Dr. Donaldson is the author of "Practical Morbid Histology" (1923), and of numerous articles in the medical journals.

Mr. S. J. Cowell has been appointed as from Sept. 1 to the University chair of dietetics tenable at St. Thomas's Hospital Medical School. Mr. Cowell received his medical education at Queens' College, Cambridge, and at University College Hospital, and since January 1923 has been assistant to Prof. E. Mellanby at the University and Royal Infirmary, Sheffield. In 1926 he opened a discussion before the Public Health Section of the British Medical Association and has published papers on non-specific desensitisation, concentration of the blood in adrenal insufficiency, effect of iodine on hyperthyroidism in man, and irradiation of milk and the healing of rickets.

Dr. H. D. Wright has been appointed as from Oct. 1 to the University readership in bacteriology tenable at University College Hospital Medical School. Dr. Wright studied at the Universities of Tasmania and Edinburgh. From 1920 until 1923 he was lecturer in bacteriology in the University of Edinburgh, and in 1921–23 assistant director of the Research Laboratory of the Royal College of Physicians, Edinburgh. Since 1923 he has been lecturer in bacteriology at University College Hospital Medical School.

Mr. S. L. Baker has been appointed as from Sept. 1 to the University readership in morbid anatomy and histology tenable at Middlesex Hospital Medical School. Mr. Baker has been senior assistant in the Bland-Sutton Institute of Pathology since July 1922 and lecturer in morbid histology at the Middlesex Hospital Medical School since May 1923.

THE Air Ministry announces that about 120 officers will be required by the Royal Air Force for flying duties during the next few months. Applicants must be between the ages of eighteen and twenty-five years, well-educated, and of good eyesight and physique. Short service commissions are granted for five years' service on the active list and four in the reserve. Application forms can be obtained from the Secretary, Air Ministry, Kingsway, London, W.C.2.

THE trustees of the Beit Fellowships for scientific research have made the following elections to fellowships tenable at the Imperial College of Science and Technology, for two years 1928–29 and 1929–30, of the value of £250 per annum: Dr. R. H. Purcell, subject of research—"Change of properties of pure substances on intensive drying; problems in catalysis with special reference to the unique influence of water." Mr. A. A. Fitch, subject of research—"(a) The metamorphic aureole of the Dartmoor granite; (b) Investigation of a part of the Central Weald." Mr. J. M. Frankland, subject of research—"Effect of constitution and treatment on the mechanical properties of steel."

THE following awards for the year 1928–29 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: Fellowships have been renewed to: Mr. C. G. Akhurst (Fellow, 1927–28, at the Rothamsted Experimental Station) for one year at the Imperial College of Tropical Agriculture, Trinidad; Mr. F. Witt (Fellow, 1927–28, at the Gas Institute, Karlsruhe) for one year in a German industrial fuel undertaking. Fellowships have also been awarded to: Mr. H. K. Cameron, University College, London; Mr. H. Diamond, University College, London; Mr. F. L. Gilbert, University College, Nottingham, and Cambridge; Mr. C. H. Lea, University of Liverpool; Mr. A. H. Loveless, of the Imperial College, London; Mr. H. Smith, of the Imperial College, London. Seventy grants-in-aid have also been awarded to young men and women employed in chemical works, to facilitate their further studies.

THE Medical Research Council announces that on behalf of the Rockefeller Foundation it has made the following awards of fellowships provided by the Foundation and tenable in the United States of America during the academic year 1928–29. These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in America before taking up positions for higher teaching or research in the British Isles. Dr. L. E. Bayliss, Sharpey Scholar at University College, London; Dr. A. V. Neale, Children's Hospital, Birmingham; Dr. F. J. W. Roughton, lecturer in physico-chemical aspects of physiology, University of Cambridge; Dorothy Stuart Russell, Baron Institute of Pathology, London Hospital; Mr. Arthur Wormall, lecturer in biochemistry, University of Leeds.

Calendar of Customs and Festivals.

July 29.

ST. MARTHA was specially venerated in Provence, where she converted the inhabitants to Christianity after her landing at Marseilles in the company of Mary (transformed into St. Mary Magdalene) and Lazarus. She is especially identified with Tarascon and Beaucaire, a famous fair being held at the latter town on her feast day. At Tarascon the saint slew the *tarasque*, a fearsome dragon-like monster which was devastating the country. This victory was afterwards celebrated in an annual procession of the *tarasque*, a representation of the monster, for long an object of great veneration. In the Revolution it was burnt by the people of Arles. A second, made some four years later, was also seized and conveyed to Beaucaire.

THE FEAST OF CHERRIES.—At Hamburg, on the feast of St. Martha, it was a custom for the children to parade the town bearing green boughs decked with cherries. This was said to commemorate the successful intercession of the children of the town in 1432, when it was threatened with destruction by the victorious Hussites.

July 30.

MACE MONDAY.—On the first Monday after St. Anne's Feast there used to take place at Newbury a mock election of 'the mayor of Bartlemas.' A dinner was provided at which bacon and beans were the chief dish. A procession took place in the course of the day, at which a cabbage on a stick took the place of the mace. Records from other localities, for example, Devonshire, indicate that bacon and beans formed the recognised dish marking Mace Monday.

August 1.

S. PETRI AD VINCULA.—A feast in veneration of the chains with which St. Peter was bound in prison, one of which was deposited at Rome and one at Constantinople. The filings from these chains were of special virtue; but they were not available for every suppliant, the use of the file at times producing no result.

GULE OF AUGUST: LAMMAS.—Various explanations have been given of these names applied to the first day of August. Medieval expositors connected gule with *gula*, and said it was so called from the cure of the daughter of the tribune Quirinus of an affection of the throat by kissing the chains of St. Peter on this day. A more probable derivation connects it with the Celtic *Gwyl* or *Wyl*, a feast.

An obviously popular etymology derives Lammas from *Lamb mass*, explaining the name as based upon a payment of a live lamb as a condition of tenure of land to the diocese of York, to be made to the Cathedral of St. Peter at York on this day. St. Peter's Pence were payable in England on the same day. In the Sarum Manual it is given as the day of the blessing of the first fruits, and it is therefore suggested that it is the *Hlaf* or loaf mass, the day of the offering of the first corn, or alternatively from *La-ith-mas*, a fanciful interpretation, based upon a meaning of *ith* as grain, especially wheat, and *mas* meaning 'mast.' In the Highlands the day is known as *Lunasdal*, not a Celtic term, which connects it with moon-worship, and it is suggested that the English name may have a similar derivation from Lunamas.

The first day of August, called Lugnasadh, was one of the Celtic quarter-days, but, with the February quarter-day, was of later introduction than the six-monthly division at May and November. It was the occasion of a number of great fairs in Ireland, and was devoted to games of a communal character. A fair was held at Tailtin, in Co. Meath, a centre of great sanctity in early times, at which Lug, the sun god, instituted games in honour of the dead. There were others almost equally celebrated at Cruachan in Roscommon and at Carman, near Wexford. These fairs, if properly observed, were reputed to ensure plenty in corn, milk, fruit, and fish, as well as prosperity generally and peace. All were connected with the cult of the dead. In the Isle of Man there are traces of a ceremonial observance in the custom of rising early on the morning of Aug. 1, climbing to the top of a high hill, and returning with water from a well known for its curative properties.

The games of the Irish fairs and feasts find a parallel in Scotland as part of a curious custom noted at the end of the eighteenth century by Dr. James Anderson. Early in the summer the herdsmen of the Lothians used to form themselves into bands according to locality, and began to build, approximately in the centre of each district, forts or mounds of turf of conical shape, rising to seven or eight feet, which were surmounted by a flag post. During the time of building, these structures were jealously guarded, as to destroy the fort of a rival faction was a great honour. On the day of the festival each band marched out from the village under a captain, armed with staves, and bearing a flag. They took up their position at the mound, and until midday either attacked another party or waited to be attacked. They then returned, and the rest of the day until sunset was taken up with games, the prize of the first race being a bonnet ornamented with ribbons and exhibited on a pole, a feature which is curiously suggestive of a head-hunting celebration.

In the Highlands, cattle were sained at Lammas. Tar was put on the tail and ears, charms said at their udders, and red and blue threads put on their tails. The vessels in which milk and butter were kept were protected from evil influences by various ceremonies with balls of hair, plants, and fire. Curds and butter were specially prepared for a feast, at which it was important that everyone should get as much as he wanted. Menses were smeared on doorposts and window frames to keep away evil influences.

In Ireland, according to Cormac's glossary, Lammas was one of the four great festivals of the Druids, which fell in February, May, August, and November, and at which fires were lighted up.

August 3.

In Ireland on the Friday, Saturday, and Sunday following Lammas, it was believed that the influence of Aynia was peculiarly potent. Aynia was one of three 'hags' or witches who were especially prominent in Irish popular belief, Aynia more particularly in the north. The three hags, Aynia, Bav, and Vera, are survivals of three pagan goddesses, Bav being the goddess of war, and Aynia the goddess of the moon. She is still regarded as closely connected with lunatics. A lunatic escaping control will make his way to 'Aynia's seat' at Dunany. Should he succeed in sitting in the 'seat' three times, he will never recover. All the rabid dogs of Ireland are drawn to the same spot. Aynia was also a patron of letters, and it is she who introduces men of learning to the next world. She possessed unbounded influence over the human form, being regarded as the vital spark which once in twenty-four hours traverses the human frame. On this account the blood-letter would never work on the days sacred to her. It was also believed that on these three days it was dangerous to bathe, nor would fishermen put to sea; if they did, one or more would be drowned before their return.

Societies and Academies.

DUBLIN.

Royal Dublin Society, June 26.—Report of the Irish Radium Committee for the year 1927. 14,306 millicuries of radon were issued during the year for therapeutic purposes. Reports are included from two of the largest users of radon recording the results of the treatment of 292 cases of malignant and non-malignant disease.—**C. Boyle, M. Murphy, and H. A. Cummins**: 'Blossom-wilt' of apple trees and 'wither-tip' of plum trees with special reference to two biologic forms of *Monilia cinerea* Bon. The results of culture and infection experiments using the 'wither-tip' and 'blossom-wilt' forms of *Monilia cinerea* show that the two forms are physiologically different. These results are in conformity with those of Wormald, and justify the distinction *forma mali* and *forma pruni* for the forms occurring on apple and plum respectively.—**T. Dillon and E. F. Lavelle**: A suggested method for the utilisation of seaweed. Seaweed might be utilised by throwing it into tanks near the shore and allowing it to decay, when the liquid running off would contain potash, iodine, and organic matter. A small-scale experiment with Laminariæ showed satisfactory iodine recovery. The organic bodies obtained were acetic, propionic, and other acids. The advantages of the suggested process are: (1) winter tangle could be used, (2) the initial operations would be carried out on the spot, and (3) the organic matter would be recovered.—**A. G. G. Leonard and P. F. Whelan**: Spectrographic analyses of Irish ring-money, and of an alloy found in commercial calcium carbide. In some museum specimens of Irish ring-money the gold sheath is incomplete, a core of white metal being exposed in places. Examination of the spark spectrum showed that this core consists of remarkably pure tin. An alloy, found in calcium carbide, which showed great resistance to acids, was found to consist of iron, titanium, and silicon. Chemical analysis showed that the percentages of these elements were about 66, 22, and 11 respectively.—**L. B. Smyth**: *Salpingium palinorsum*: A new carboniferous coral. This new genus and species of coral occurs in the carboniferous limestone of Hook Head, Co. Wexford, Ireland, at a level correlated with the C_1 sub-zone of Vaughan. It consists of a tube about 4 mm. in diameter, with strongly thickened walls. Simple tabulæ occur at intervals of 2-4 mm., and septal striæ are seen in places, being elsewhere presumably engulfed by stereoplasm. At irregular intervals the tube is surrounded by thin trumpet-like expansions, three or four times the diameter of the tube, bearing septal ridges. It is suggested that the structure is due to rejuvenescence. The affinities are doubtful.—**L. P. W. Renouf**: A preliminary account of Loughine (Lough Hyne), Co. Cork. Loughine or Lough Hyne, situated some sixty miles south-west of the city of Cork, though only a little more than a quarter of a square mile in area, presents many interesting features. It is land-locked except at the south-east corner, where the tide rushes in and out with great force through a narrow neck less than twenty yards in width, and on account of a deep sill it continues to ebb for more than three hours after the beginning of the flood tide from the Atlantic twelve hundred yards to the south. The lough attains a depth of twenty-nine fathoms. The Laminarian zone is practically absent, with the result that at neap tides, when on account of the sill the ebb from the lough is greatest, the Coralline zone is exposed, and a number of what are ordinarily deep-water forms are found in as little as two inches of water. Though the number of species is not remarkable, many of them are represented by countless numbers of individuals, and at least one which appears to be new, for which the name *Ethropodium hibernicum* is tentatively suggested, has been discovered.

CAPE TOWN.

Royal Society of South Africa, May 16.—**John F. V. Phillips**: The influence of *Usnea* sp. (near Barbata, Fr.) upon the supporting tree. Work at the Research Station, Deepwalls, Knysna, on the relationship between *Usnea* and the *Podocarps* has shown that the lichen is definitely detrimental, in that its fungal component is parasitic upon the tissues external to (and sometimes internal to) the cork-cambium. Vigorous crowns may be infected as well as defective ones. The lichen cannot develop luxuriantly under the conditions of light, temperature, and humidity holding in undisturbed high forest, but grows apace when these factors are suddenly and severely altered by heavy exploitation.—**J. S. Thomas**: The action of ammonia on germanium tetrachloride: germanium imide. Ammonia reacts vigorously with germanium chloride, giving a white substance having a composition $GeCl_2 6NH_3$. When treated with ammonia under pressure, a compound having the formula $GeCl_4 16NH_3$ is produced, which may be a mixture of $Ge(NH)_2$, with $4NH_4Cl$. An apparatus was constructed in which the preparation of the germanium chloride, treatment with ammonia, etc., could be carried out without at any period opening the vessel to the air. In this way a product was obtained the analysis of which corresponded to 99·2 per cent $Ge(NH)_2$. The compound is a white powder which reacts very violently with water and combines directly with hydrogen chloride, forming the imide hydrochloride.—**W. W. Southwood**: Compounds of germanium tetrachloride with certain amines: (1) Compounds with aniline. The product formed by germanium chloride and aniline is a mixture of aniline hydrochloride and the substituted di-imide hydrochloride. (2) Compounds with ethylamine. Excess ethylamine distilled into $GeCl_4$ produced $GeCl_4 6C_2H_5NH_2$. In ethereal solution the free substituted di-imide $Ge(NC_2H_5)_2$ was obtained. The compound containing six molecules of amine has a high dissociation pressure, and yielded the substituted di-imide hydrochloride.—**James Moir**: Colour and chemical constitution (Part 24). A complete investigation of the triphenylcarbinol or 'aniline' dyes. There are 23 possible dyes and these possess in all 75 absorption bands in solutions of differing reaction (pH). A theory and method of calculation from chemical constitution are put forward explaining nearly seventy of the bands.—**Letitia Starke**: The spermatogenesis of *Holopterna alata*. The somatic number of chromosomes is 20, the reduced number 10. There is slight heteromorphism, but an *X Y* pair is not recognisable. As in other Hemiptera, there is a diffuse stage intercalated in the heterotype prophase.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Mar. 13.—**C. Juel**: 'Elementary' curves and surfaces. An 'elementary' curve in space is a closed continuous curve composed of a finite number of arcs of the third order; for example, certain curves of the fourth order. It can exist non-analytically. An 'elementary' surface similarly is composed of a finite number of parts of the second or third order; for example, a cyclic ovaloid. Certain conditions of continuity being given, it can only exist algebraically.

April 27.—**D. la Cour**: Recent research in Greenland on terrestrial magnetism. For the study of the

magnetic field of the earth and certain relationships between the earth and the sun, research on magnetic variations near the magnetic pole are of particular interest. Long series of observations in Arctic regions are required and, at the suggestion of the International Union of Geodesy and Geophysics, Denmark established a magnetic observatory at Godhavn two years ago for this purpose. This observatory is farther north than any other, and by its special equipment for measuring the vertical intensity, will produce most valuable results. The observations so far show a characteristic diurnal variation of the magnetic elements, and indicate a relationship between magnetism and rotation of the earth and between the magnetism and rotation of the sun.—**Oluf Thomsen**: The existence of four blood-groups in man, illustrated by 275 descendants of 100 *AB*-matings (and 78 children with only one *AB*-parent). The object was to discover if Bernstein's hypothesis of three allelomorph genes for blood-groups (*A*, *B*, *R*) is correct. The results are in accord with those to be expected on Bernstein's theory and completely inconsistent with the hypothesis of two independent gene pairs. The latest modification of Bernstein's hypothesis (by Furuhata, Ichida, and Kishi) will not withstand serious criticism.

SYDNEY.

Linnean Society of New South Wales, May 30.—**F. A. Craft**: The physiography of the Cox River basin. Cox's River rises near Wallerawang and Lithgow, and pursues a winding course to join the Wollondilly River in Burragorang Valley. Along the course of the main river and certain of its tributaries there are remarkable ancient valleys, which have been trenched by deep modern canyons. Three of these valleys are recognised, namely, Lithgow - Wallerawang (3100 feet); Kanimbla (2200 feet); and Kowmung (500 to 2800 feet). To the north of Cox River the average elevation is 3300 feet; to the south, the plateau area around Jenolan averages 4000 feet. The plateau has been elevated in stages; the uplift is of a complex nature, involving an earlier northern and a later southern and western phase; and there have been great changes in stream-flow since the commencement of uplift.—**R. J. Tillyard**: The larva of *Hemiphlebia mirabilis* (Odonata). Full-grown larvæ of this tiny damselfly, considered to be the most archaic type of Odonata at present existing, were discovered last November in a backwater of the Goulburn River at Alexandra, Vic. The most interesting characters are the primitive mandibles showing characters suggestive of Mayfly larvæ; the trifid hypopharynx; the remarkably composite type of labial mask, which shows Lestid and Synlestid affinities and is the only mask known to possess both glossæ and paraglossæ; the primitive gizzard; the Synlestid type of caudal gills; and, above all, the extraordinary scheme of wing-tracheation, which differs from that of all other Odonata in possessing no tracheal supply for the interpolated veins, and no anal trachea.—**Ida A. Brown**: The geology of the south coast of New South Wales (Part 1). The palæozoic geology of the Moruya district. The metamorphosed sediments of the district consist of apparently unfossiliferous slates, phyllites, and quartzites, which were folded and faulted about meridional axes probably at the close of the Silurian period. In late (?) Devonian time this series was intruded by a composite batholith, which is elongated in a direction of structural weakness running north-north-west and south-south-east, and produced well-marked contact metamorphic effects in the invaded sediments. The igneous rocks comprising the batholith form a complete subalkaline or calcic igneous complex, and include three main plutonic types—diorite-gabbro, tonalite-granodiorite, and biotite-granite—which were injected in order of decreasing basicity and increasing alkalinity.

VIENNA.

Academy of Sciences, Mar. 8.—**O. Deutschberger**: The compounds participating in the composition of the residual carbon and residual nitrogen in blood, especially the oxyprotein acids. More than half of the carbon in dealbumenated blood appears unexplained. The oxyprotein acids form barium salts soluble in water but insoluble in alcohol. These substances represent break-down products of albumen. Analyses were made of defibrinated horse blood. The atomic ratios of the total oxyprotein acid fraction gave $C_{100}H_{144}N_{24}$.—**E. Steinach** and **H. Kun**: The secretion of the male gonad and its dependence on the hormone of the frontal lobe. Experiments on infantiles, eunuchoids and seniles (Part 2). The pituitary extract of bull and cow is alike active; it influences infantile testicles and ovary, it is not sex-specific. Active extract can be obtained from urine of pregnancy. But pituitary extract is not itself a sexual hormone, it does not work on castrates and it cannot replace the sexual hormones; it is only an activator of the sex-glands. Occasional eunuchoid rats were sexually developed after pituitary injections; aged male rats were sexually reactivated.—**J. Schaffer**: The so-called proliferous atrophy of fatty tissue. Examination of the epiglottis of a menagerie elephant which died of starvation during the War.—**M. Kohn** and **R. Kramer**: Halogenated *o*-anisidine (Communication 30 on bromo-phenols).—**M. Kohn** and **R. Kramer**: On 3, 4, 5-trichloro-phenol (Communication 31).—**M. Kohn** and **M. K. Feldmann**: Preparation of 2, 6-dibrom-*m*-xyloquinone from symmetrical xylenol (Communication 32).—**M. Kohn** and **E. Gurewitsch**: Chloro- and bromo-pyrogallol-ether (Communication 33).—**A. Smekal**: Diffusion and recrystallisation. Recrystallisation is a stabilisation procedure which takes place in certain temperature ranges by the diffusion of free ions in the gaps of the crystal lattice. The possibility of diffusion can be examined by electric conductivity measurements.—**F. M. Exner**: The circulation of cold and warm air between high and low latitudes. The deviations of the daily temperatures from the average temperatures of the same places for 90 winter days and for 129 places of the northern hemisphere were plotted. This led to the detection of streams of cold or warm air from higher to lower latitudes or vice versa.—**J. Mayer** and **O. Hiedl**: The absolutely smallest discriminants of biquadratic number-bodies.—**N. Hofreiter**: A new reduction theory for definite quaternary quadratic forms.—**K. W. F. Kohlrausch**: Energy losses and ionisation in the passage of α- or β-particles through matter. An attempt to determine the dependence of (1) loss of velocity, (2) range, and (3) differential ionisation upon the velocity of the particles and upon the material.—**E. Tschermak**: Hybridisation results in lentils and beans.—**O. Dischendorfer**: Condensation of aldehydes with phenols (2). On *m*-nitrobenzal-di-β-naphthol.

Mar. 15.—**J. Pollak**, **E. Gebauer-Fülnegg**, and **E. Blumenstock-Halward**: The action of chloro-sulphonic acid on phenols.—**J. Pollak** and **E. Blumenstock-Halward**: The determination of the constitution of β-naphthol-disulpho-chloride.—**J. Pollak**, **E. Riesz**, and **Z. Kahane**: Amino-thio-phenol derivatives.—**E. Späth** and **F. Wessely**: The active components of genuine coto bark. The constitution of cotoine.—**E. Späth** and **G. Burger**: A synthesis of pyridin derivatives.—**F. Sigmund**: Catalytic hydration of the nucleus of aromatic and fatty aromatic aldehydes in

the form of their acetals (1). Hexa-hydro-phenyl-acetaldehyde-dimethyl-acetal.—F. Schiller: The fruit of *Viscum album* and *Loranthus europaeus* and the production of bird-lime. *Viscum* does not yield a sufficiently sticky material, *Loranthus* does; it contains caoutchouc.—O. Gugenberger: Contributions to the geology of Asia Minor with special reference to the Anatolian lias.—F. Hölzl and F. Viditz: The alkylisation of hexa-cyano-chromic acid.—E. Rona: The preparation of polonium from radium compounds and active lead salts. Precipitation with hydrogen sulphide.—S. Meyer: The disintegration constant of actinium. The half period is 13·4 years.—K. Fritsch: Observations on flower-visiting insects in Styria, 1907.—A. Winkler: Studies on the interior Alpine tertiary deposits and their relations to the *Augenstein* fields of the northern Alps.—A. Kieslinger: The Lavant valley disturbance and its relation to the tectonics of the eastern Alps.

April 26.—R. Wegscheider and J. Mehl: Systems $Na_2CO_3 - NaHCO_3 - H_2O$. Two double salts were found, one of them anhydrous $Na_2CO_3 . 3 NaHCO_3$. Experiments were tried at various temperatures up to 94·5°, and with addition of 24 gm. common salt to 100 gm. water.—A. Kailan and Y. M. Diab: Velocity of esterification of mono-amino-benzoic acid and of the 1- and 2-pyridin carboxylic acids in glycol and glycerine.—A. Kailan and E. Krakauer: Velocities of esterification of the nitro-benzoic acids in ethylene-glycol and of the naphthoic acids in glycerine.—J. Kozeny: On developed turbulence.—F. Feigl and H. Gleich: Relations between atom grouping and specific affinity (7). Metallic salts of imid-azol derivatives.—F. Feigl and E. Bäcker: Addition compounds of thallium enol salts with carbon disulphide (8).—F. Feigl and A. Deutsch: Silver and mercury salts of amido-benzo-hnazol.—F. Feigl and E. Chargaff: The reactivity of iodine in organic solvents.—G. Machek and A. Graf: The course of the Friedel and Craft reaction in anthraquinone-1, 2-dicarboxylic acid anhydride.—V. F. Hess and O. Mathias: Atmospheric electricity (70). Researches on oscillations in the cosmic ultra-gamma-radiation on the Sonnblick (3100 metres) and in the Tyrol.—E. Guth: Maxwell's equations and Dirac's quantum theory of the electron.—F. Heritsch: Tectonic questions in the Carnic carboniferous.—F. Heritsch: Notes on the lower Permian in the Carnic Alps.—F. Werner: Contributions to the knowledge of the fauna of Greece, especially of the Aegean Islands.—R. Ebner: Coleoptera, C. (Scientific results of the zoological expedition to the Anglo-Egyptian Soudan undertaken by F. Werner, 1914, No. 24).—A. Rollett: The acid constituents of sandarac resin.—M. Kuban: Potassium and rubidium radiation.—M. Blau: Photographic intensity measurements of polonium preparations.—S. Wolff: The ultra-violet spectrum of radium emanation. More than 100 new lines between 3600A. and 2400A. are recorded.—R. Schumann: Some new investigations on fluctuations of polar altitude.—V. Oberguggenberger: Contribution to the establishment of a standard system of effective wave-lengths.—A. Steuer: A new *Paracineta* from the South Atlantic.—K. Ehrenberg: *Ursus Deningeri* and *Ursus spelaeus*. A comparison of skull, jaw, and teeth of the Mixnitz cave bears with Reichenau's specimens in the Mainz museum.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 5, May). J. R. Oppenheimer: On the quantum theory of the autoelectric field currents. An expression obtained for the field necessary to make an electron leave the nucleus leads to very low values of the ionising potential for electrons in metal (the work function). It is concluded that the 'autoelectrons' are only given off from a wire at points where the field strengths are abnormally high. This is in agreement with the experimental finding that craters surrounded by protuberances of the necessary order of magnitude occur on the wire.—Edwin H. Hall: (1) The Fermi statistical postulate; examination of the evidence in its favour. While Pauli's 'equivalence principle' as applied to the electrons within an atom may be accepted, Fermi's extension of it to all the molecules of an ideal gas is regarded as not yet justified.—(2) Sommerfeld's electron-theory of metals. A critical discussion of the theory as applied to various electrical effects.—(3) Electron 'free path' and supra-conductivity in metals. A special meaning is given to the so-called mean free path of the electron-gas particles in a metal; it is assumed that the path of an electron is not necessarily a straight line and that it is terminated by collision and capture by a positive ion. This leads to reasonable explanations of specific heat and the relation of conductivity to temperature using classical formulae.—Elmer Dershem: Dispersion of long wave-length X-rays in platinum and calcite. The spectrograph and other apparatus were mounted in a large evacuated bowl, thus permitting of great wave-length resolution. The beam of X-rays was collimated by two slits, reflected from a mirror surface of platinum or calcite and on to a gypsum crystal, the effect being recorded on a photographic plate. The maximum angle at which reflection occurred was measured. With the wave-lengths used, dispersion for platinum increases with wave-length; calcite showed anomalous dispersion near a K-absorption limit.—L. DuSault and Leonard B. Loeb: Mobilities of gaseous ions in SO_2 and $SO_2 - H_2$ mixtures. Mobilities were observed in sulphur dioxide at atmospheric and lower pressures; they appear to decrease slightly with pressure, but this is probably due to higher purity of the gas used in the low pressure experiments. In mixtures with hydrogen, the negative mobility is always less than the positive; positive mobilities so high as 22 cm./sec. per volt/cm. were observed with low concentration of the purer sulphur dioxide.—R. Cumming Robb: Is pituitary secretion concerned in the inheritance of body-size? Comparison of the weights of the pituitary bodies in giant (Flemish) and dwarf (Polish) male rabbits and their hybrids shows no characteristic difference which can be correlated with differences in growth rate. In common with other organs, the pituitary maintains a rectilinear logarithmic relationship to body weight, suggesting that all these organs are regulated by a common growth reaction.—Cecilia H. Payne: On the contours of stellar absorption lines, and the composition of stellar atmospheres. The H and K lines of ionised calcium and the Balmer lines of selected stars show differences from class to class and from super-giant to dwarf within the same spectral class. The observations are in general agreement with Unsöld's formula, which can therefore be used virtually to weigh the atmospheres of individual stars.—George R. Putnam: (1) Regional isostatic reduction of gravity determinations. The departures from complete local compensation must be considered in a complete reduction of gravity observations. A regional reduction gives anomalies in better accord with observations and may be represented as a warped surface lying between the earth's surface and the average level of the region. Regional compensation extends 100 miles from a station and further for great mountains.—(2) Proof of isostasy by a simple gravity reduction method. The computation is based on the attraction of indefinitely extended horizontal plates and gives a fair approximation to the value of gravity

reduced to sea-level. The method was used by the author in 1895.—Marston Morse: Singular points of vector fields under general boundary conditions.—E. T. Bell: Remark on the number of classes of binary quadratic forms of a given negative determinant.—Harry Merrill Gehman: (1) Concerning certain types of non-cut points, with an application to continuous curves.—(2) Concerning irreducible continua.—Julian Coolidge: Criteria for the simplification of algebraic plane curves.

Official Publications Received.

British.

Harper Adams Agricultural College, Newport, Salop. Pp. 80. Report of the Advisory Department, 1927–1928. (Advisory Report No. 3.) Pp. 24. The National Institute of Poultry Husbandry. Pp. 48. (Newport, Salop.)

Ceylon Journal of Science, Section A: Botany; Annals of the Royal Botanic Gardens, Peradeniya. Edited by A. H. G. Alston. Vol. 11, Part 1, May 28th. Pp. 111. (Peradeniya: Department of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the year 1927. Pp. 11. (Cape of Good Hope.)

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1927. Pp. 18. (Salisbury.)

Proceedings of the Society for Psychical Research. Part 107, Vol. 38, July. Pp. 49-101. (London: Francis Edwards, Ltd.) 2s.

Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees in the University of Cambridge for the Academical Year 1926–1927. Published by Authority. Pp. 90. (Cambridge: At the University Press.)

Hull Museum Publications. No. 153: Hull and the Fishing Industry. By T. Sheppard. (Commercial Museum Handbooks, No. 2.) Pp. 15. No. 154: Early Means of Transport in the East Riding. By T. Sheppard. Pp. 36. (Hull.)

Speech delivered by Marcus Garvey at Royal Albert Hall, London, England, on Wednesday evening, June 6th, 1928, in setting forth 'The Case of the Negro for International Racial Adjustment' before the English People. Pp. 31. (London: Universal Negro Improvement Association.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1115 (Ae. 288): The Importance of 'Streamlining' in relation to Performance. By Prof. B. M. Jones. (T. 2519.) Pp. 15+2 plates. 9d. net. No. 1134 (Ae. 304): Wind Tunnel Tests with High Tip Speed Airscrews. The Characteristics of Airscrew Section R. and M. 322, No. 4 and R.A.F. 32. By W. G. A Perring. (T. 2563.) Pp. 8+3 plates. 6d. net. (London: H.M. Stationery Office.)

Annual Report of the Auckland Institute and Museum for 1927–28, adopted at the Annual General Meeting held on 21st May 1928. Pp. 39. (Auckland, N.Z.)

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1927 May 19—1928 May 18. Pp. 3. (Cambridge.)

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 6, 1925–1926. Pp. xi+240+24 plates. (London.) 20s.

Loughborough College, Leicestershire. Calendar, Session 1928–29. Pp. xiv+228+71 plates. (Loughborough.) 2s. 6d. net.

University of Cambridge: Solar Physics Observatory. Fifteenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1927 April 1—1928 March 31. Pp. 6. (Cambridge.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1928. Pp. xii+60. Bulletin No. 35: Trials of Weed Killers on Garden Paths. By Alfred Hill. Pp. 6. (Aberdeen.)

University College of Wales, Aberystwyth. Reports submitted to the Court of Governors, October 19th, 1927. Pp. 114. (Aberystwyth.) 1s.

The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, corrected to 30th April 1928. Pp. 388. (London.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute, to be presented at the Yearly Meeting in May 1928. Pp. xlix+78. (London: Gresham College.)

The British Institute of Philosophical Studies. Annual Report and Statement of Accounts for the Year ended 31st March 1928, to be presented at the Third Annual General Meeting of the Members to be held at the Royal Society of Arts, 18 John Street, Adelphi, London, W.C.2, on Monday, 16th July 1928, at 5.30 o'clock. Pp. 20. (London.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 16, Technological Series No. 11: Technological Reports on Standard Indian Cottons, 1928. By A. James Turner. Pp. vi+118. (Bombay.) 2 rupees.

City of Norwich. The Report of the Castle Museum Committee to the Council, 1927. Pp. 22. (Norwich.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1120 (Ae. 293): Analysis of Experiments on an Airscrew in various Positions within the Nose of a Tractor Body. By C. N. H. Lock. (T. 2507.) Pp. 20+8 plates. 1s. net. No. 1135 (Ae. 305): The Effect of Compressibility on the Lift of an Aerofoil. By H. Glauert. (T. 2518.) Pp. 8+1 plate. 6d. net. (London: H.M. Stationery Office.)

British Empire Cancer Campaign. Annual Report of the Grand Council presented at the Meeting held at the House of Lords, 9.7.28. Pp. 141. (London.)

Board of Education. Prospectus of the Royal College of Art, S. Kensington, London. Session 1928–1929. Pp. v+28. (London: H.M. Stationery Office.) 4d. net.

International Geographical Union. Programme for the International Geographical Congress, London, July 14-17, and Cambridge, July 18-25, 1928. Pp. 16. (Cambridge.)

Foreign.

Annuaire de l'Observatoire Royal de Belgique. Par P. Stroobant. 96me année, 1929. Pp. iii+160. (Uccle.)

Bibliothèque de l'Observatoire Royal et de l'Institut Royal Météorologique de Belgique à Uccle. Catalogue alphabétique des livres, brochures et cartes, préparé et mis en ordre par A. Collard. Tome 3: Accroissements de 1913–1922. Pp. 432+xlviii. (Uccle.)

Unione Astronomica Internazionale. Immagini spettroscopiche del bordo solare osservate à Catania, Zurigo e Zô-Sè negli anni 1923 e 1924 pubblicate per Cura del R. Osservatorio astrofisico di Arcetri. Pp. 10+14 tavole. (Firenze.)

Publications of the Washburn Observatory of the University of Wisconsin. Vol. 15, Part 1: Photo-Electric Photometry of Stars, by Joel Stebbins; Vol. 15, Part 2: Photo-Electric Studies of Four Variable Stars, by Charles Morse Huffer. Pp. 185. (Madison, Wis.)

University of California Publications. Publications of the Lick Observatory, Vol. 16: Stellar Radial Velocities. Pp. v-xlv+399+plates. (Berkeley: University of California Press; London: Cambridge University Press.)

Proceedings of the United States National Museum. Vol. 73, Art. 4: New Helminth Parasites from Central American Mammals. By Emmett W. Price. (No. 2725.) Pp. 7+2 plates. Vol. 73, Art. 7: A new Fossil Reptile from the Triassic of New Jersey. By Charles W. Gilmore. (No. 2728.) Pp. 8+3 plates. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Bulletin 788-F: Topographic Instructions of the United States Geological Survey. F: Map Compilation from Aerial Photographs. By T. P. Pendleton. Pp. iii+379-419. 15 cents. Bulletin 796-D: Geology and Oil and Gas Prospects of North-Eastern Colorado. By Kirtley F. Mather, James Gilluly and Ralph G. Lusk. (Contributions to Economic Geology, 1927, Part 2.) Pp. iv+66-124+plates 14-18. 20 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 577: Plants as Indicators of Ground Water. By Oscar Edward Meinzer. Pp. v+95+12 plates. 25 cents. Water-Supply Paper 596-G: Chemical Character of Waters of Florida. By W. D. Collins and C. S. Howard. (Contributions to the Hydrology of the United States, 1927.) Pp. iv+177-238. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1927. (Publication 2957.) Pp. ix+188. (Washington, D.C.: Smithsonian Institution.)

United States Department of Agriculture. Technical Bulletin No. 61: Wild Birds introduced or transplanted in North America. By John C. Phillips. Pp. 64. 10 cents. Farmers' Bulletin No. 1561: The Porto Rican Mole Cricket. By W. A. Thomas. Pp. ii+9. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 73, Art. 11: A Prehistoric Pit House Village Site on the Columbia River at Wahluke, Grant County, Washington. By Herbert W. Krieger. (No. 2732.) Pp. 29+7 plates. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 139: The Photogalvanic Cell furnished with Silver Iodide Electrodes, and its Application to Photometry and Illuminometry. By Satoyasu Iimori and Toshimasa Takebe. Pp. 131-160+plate 15. 45 sen. No. 140: Über die Stereoisomerie des 8-Oxydekahydrochinolins und seiner Derivate. Von Shin-ichiro Fujise. Pp. 161-171. 20 sen. No. 141: Quantitative Determination of Hæmoglobin by means of the Silver Iodide Photogalvanic Cell. By Koichi Uchiyama. Pp. 173-184. 20 sen. (Tokyo: Iwanami Shoten.)

University of Illinois: Engineering Experiment Station. Bulletin No. 177: Embrittlement of Boiler Plate. By Prof. Samuel W. Parr and Frederick G. Straub. Pp. 67. 40 cents. Bulletin No. 178: Tests on the Hydraulics and Pneumatics of House Plumbing, Part 2. By Prof. Harold E. Babbitt. Pp. 62. 35 cents. (Urbana, Ill.)

Physikalisch-chemisches Institut der Universität Zurich. Physikalisch-chemische Übungen. Von Dr. W. Kuhn. Pp. 102. (Zurich und Leipzig: A. G. Gebr. Leemann und Co.)

University of California Publications in American Archeology and Ethnology. Vol. 23, No. 8: Pottery-making in the South-west. By E. W. Gifford. Pp. 353-373. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 25 cents.

Berichte der Naturforschenden Gesellschaft zu Freiburg i Br. Band 28, Heft 2. Pp. ii+93+48+24+45+6. (Freiburg i. Br.: Speyer und Kaerner.)

Proceedings of the American Academy of Arts and Sciences. Vol. 63, No. 1: Magnetostriction Oscillators. An Application of Magnetostriction to the Control of Frequency of Audio and Radio Electric Oscillations, to the Production of Sound, and to the Measurement of the Electric Constants of Metals. By George W. Pierce. Pp. 47+3 plates. 90 cents. Vol. 63, No. 2: A Dynamic Study of Magnetostriction. By K. Charlton Black. Pp. 49-66. 45 cents. (Boston, Mass.)

Annalen van de Sterrewacht te Leiden. Deel 14, Vierde Stuk: Measures of Double Stars made with the 26½- and 9-inch Grubb Refractors of the Union Observatory at Johannesburg, 1925.6–1928.2. By W. H. van den Bos. Pp. x+148. Deel 16, Derde Stuk: The Motion of Hyperion. By J. Woltjer, Jr. Pp. vii+139. (Leiden.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 41: Accredited Higher Institutions. Pp. v+40. (Washington, D.C.: Government Printing Office.) 10 cents.

Catalogue.

Recent Work on Absorption Spectrography: a Bibliography selected by Dr. Wallace R. Brode. Pp. 8. (London: Adam Hilger, Ltd.)

SATURDAY, AUGUST 4, 1928.

CONTENTS.

Education by Radio.

INFORMAL instruction, which need be neither illogical nor discrete, nor even so completely popularised in its presentation as to lack essential accuracy of fact and deduction, is perhaps as vital a force in the cultural development of a nation as its formal educational system. The new power of the broadcast message gives to the world a new university without matriculation and, what is perhaps more attractive, without examinations; a university the teaching of which is not only extra-mural but is also offered as a free gift to anyone who cares to go to the trifling expense and trouble of accepting it. As such it is in no sense a competitor with schools and colleges, nor ever can be; indeed, its success in Great Britain has been largely due to the co-operation which has been forthcoming from professional educators and their institutions.

In the United States of America the evolution of radio broadcasting has permitted a regular collaboration between the University of Pittsburgh and the radio station KDKA of the Westinghouse Electric and Manufacturing Co., a collaboration which has now completed four years of public service. Education by radio has its limitations and its pitfalls, as well as its attractions, and those responsible for these series of lectures have done well to emphasise that arm-chair listening forms no short cut to knowledge and culture, although it may add in no small measure to the sum of human happiness by providing mental stimulus, and widening vision of some of the less tangible matters of moment. Nothing can adequately function as a substitute for the influence of mind upon mind that comes of personal contact, but broadcasting at least provides a kind of one-way traffic which may well awaken response in many hundreds of thousands of minds which would otherwise be denied the opportunity of guidance towards thought extending beyond their immediate affairs.

The possibilities of this social service are, in fact, so vast that it would be as profitable at this stage to attempt to lay down rules for its development, or even to comment in detail on what has already been accomplished, as it would have been in Caxton's day to specify the contents and format, or to review the influence, of printed books. As an example, however, of the scientific side of the service, as offered outside Great Britain, we may briefly describe the contents of four booklets reproducing talks delivered by research specialists of the Mellon Institute of Industrial Research

under the auspices of the Pittsburgh collaborative scheme.

In "Science and Industry" (Radio Publication, No. 9) there are seven talks on such subjects as iron and steel, natural gas, petroleum, coal and coke, glass, and clay products; "Science in the Home" (No. 23) includes eleven talks on foods and food values, beds, fuel, textiles, disinfection, utensils, and structural materials. "Automobile Engines" (No. 28) formed the subject of six talks, which were doubtless appreciated by many thousands of motorists whose knowledge of the 'how and why' may previously have left something to be desired, whilst the seven talks on "Wearing Apparel, its Manufacture, Utility, Selection, and Care" (No. 37), must have appealed to an even wider circle. The list contains references to series of talks on "Conversations with a Philosopher," "Evolution and Heredity," "American Foreign Policy," "The Naturalist Afield," "Man and the Earth." The technical lectures mentioned form, of course, only one aspect of the educational edifice, and equally good use is being made elsewhere of similar opportunities for public service; but we feel that the enterprise of the University of Pittsburgh and the Westinghouse Company deserves both congratulation and encouragement.

A Directory of Specialised Information.

The Aslib Directory: a Guide to Sources of Specialised Information in Great Britain and Ireland. Edited by G. F. Barwick. Introductions by Sir Frederic G. Kenyon and Sir Ernest Rutherford. Published with the Financial Assistance of the Carnegie United Kingdom Trustees. Pp. xiv + 425. (London: The Association of Special Libraries and Information Bureaux; Oxford University Press, 1928.) 21*s*. net.

TRULY has it been said, "Of making many books there is no end." It is, however, a curious reflection on the perspicacity of the human intellect that mankind should continue to groan at the weariness of much study, while making so little effort to diminish the burden, either by attempting to limit the rate of increase of material, or by considering how to improve the method of handling it.

"'Tis pleasant sure to see one's name in print,
A book's a book although there's nothing in't."

So the world's production continues to be mostly in books.

Recently in Great Britain a serious attempt was made to estimate the magnitude of this output. From the "World List of Scientific Periodicals" we learnt that scientific and technical information has been published during the present century in some twenty-five thousand periodicals, besides separate books. Perhaps, of these periodicals, some fourteen thousand of those now current may contain useful matter. If then we might make a guess, that the average annual number of separate articles in a scientific journal is of the order of one hundred, the total yearly output of scientific papers might be taken as about one million or more. Thus at least we know now, that in order to find what information has been published on a given subject, we have to sort and index each year a million articles or notices published in periodical literature in addition to works issued separately. How to accomplish this task is a problem that must be solved, unless we are content to allow much of this tremendous volume of useful information to run to waste for ever.

It has been shown elsewhere that one solution of the problem is the general adoption of a standard classification, so that all those engaged in indexing information may join in a common movement for the common good. Now, it has been calculated that there are, in the Science Library at South Kensington alone, some forty million published bibliographical notices. So that the total number of published index-titles appears to be comparable with the total number of scientific papers issued. To produce a comprehensive index, therefore, requires merely the organisation of a quantity of energy, comparable with that which is now being expended uneconomically in isolated bibliographical efforts.

The work under notice makes a further contribution to the diagnosis of the extent of the malady. It does not profess to cure the evil. There exist, in Great Britain alone, some thousands of agencies, working by multifarious methods, for the purpose of collecting books or information on special subjects. The "Aslib Directory" is a worthy attempt to make a list of such agencies, and serves to indicate the vast amount of labour that is actually being expended in collecting information. While fully appreciating the value of this important contribution to bibliographical data, it is necessary to take exception to some remarks in the introduction to the work. After referring to the object of the Association of Special Libraries as being "to serve the need of the research worker," and adverting to similar organisations abroad, the introduction goes on to say "the fear is some-

times expressed that all this complex machinery may defeat its own end. The universal bibliographies which some desire are likely to break down through their own weight. The bulk of such work would be crushing, its ramifications bewildering; it is almost impossible that it should be up to date, and the research worker is in danger of being delayed as much as he is helped by it. From this danger the present Directory, so far as I can judge, is free. It is not a bibliography of universal knowledge, but merely a guide to tell the worker where special collections dealing with his subject are to be found. There he can search for the special bibliographies of his subject, *if* he needs them." The italics are ours.

It is a pity that there should be a misunderstanding of the aims of those who are seeking, by making the best use of the energy available, to produce a workable index to the information which is now lying buried and useless on the library shelves. As has been seen above, the bulk of such an index would be no greater than that of the present bibliographical output; its ramifications would be reduced to a single system, and it would be as up-to-date as the printing press. The Director of the research laboratory of a large industrial organisation, Dr. Mees, says, in his "Organisation of Industrial Scientific Research": "It should certainly be possible for large libraries to keep such numerically indexed files [of all science] to which reference could be made by correspondence by any research worker." If scientific men consider such an index to be desirable, or even necessary, are they not entitled, after having made an exhaustive study of the question, to decide whether or not it is possible? At any rate, the authors of the undertaking are determined to see it through.

However, the work under review must be judged on its merits, apart from any misunderstandings on the question of principle. The Directory brings to the notice of those in search of information, collections of material, whether in print or manuscript, of the existence of which they may be unaware. The arrangement is alphabetical, according to the selected name of the subject considered. Such a system is not unsuited to the classification of a comparatively small range of subject-headings, and enables the collections relating to a given subject to be found with ease. The editors are to be congratulated on the mass of material that they have been able to gather into their inventory. The collection is necessarily incomplete in a first edition, and apparently the editors have been hampered by the need of completing the volume within a given time. But undoubtedly much care has been bestowed on the compilation of the work, and it will be indispensable to all those who are interested in the supply of, or research for, information.

Without wishing to detract from the considerable merit of the publication, a few words of criticism are necessary. A certain lack of proportion is evident in the number of items catalogued under the different headings. For example, the information gathered under the heading "Postage Stamps" occupies 81 lines, and includes twelve periodicals; while that under "Zoology" extends to only 57 lines, without indicating any periodicals. The "Zoological Record" appears to have been omitted. Incidentally, why should scientific periodicals be referred to as "Press"? Some of the entries are even more extraordinary. The section on "Bibliography" comprises only fourteen entries, which include no more than two periodicals, and reference is made to the million cards on a single system of the Subject-matter Index at the Science Library merely as "An extensive collection of bibliographies." Under "Periodicals" the only collection catalogued is the "Loan Library of Periodicals indexed in the Subject Index to Periodicals" of about two hundred and fifty sets dating from 1915 onwards. No mention whatever is made of the great collections in the National Libraries, which include many thousands of complete sets of periodicals. Some imperfections are inevitable in the first edition of a work of this magnitude, and it is to be hoped that in future editions it will be possible to remove such blemishes.

S. C. BRADFORD.

Theoretical Astrophysics.

Astronomy and Cosmogony. By Sir J. H. Jeans. Pp. x + 420 + 16 plates. (Cambridge: At the University Press, 1928.) 31*s.* 6*d.* net.

SINCE the beginning of our present era, astronomy has been considered to be the foremost of exact sciences, and there can scarcely be any doubt that the idea of law and order in the linking of natural phenomena was first forced upon the dawning mind of man by the regular march of the stars. In the course of time, however, astronomical theory has been left behind by the rapidly increasing wealth of observational data to such an extent that present-day astronomy must largely be classified among the descriptive sciences, in

spite of the triumphs of celestial mechanics and the arduous work done during the last fifteen years to raise *theoretical astrophysics* to the rank of a separate science. Astronomy is therefore more than ever a promising field for theoretical research, and Sir J. H. Jeans's book, which aims at summarising the present status of the young science, will undoubtedly provide inspiration to theoretical astrophysicists; at the same time it will encourage astronomers doing observational routine work to make enhanced efforts, and will disseminate the knowledge of modern astronomy among workers in allied sciences.

The division of the book in principal sections is not quite so clear as might have been desired, but there is no difficulty in distinguishing three main parts. First, there is naturally given a summary and survey of salient facts in astrophysics. Next comes a series of chapters on various subjects which, essentially, give an outline of the conceptions and points of view which play the principal part in the later theoretical deductions. The rest of the book, which is its main part, is devoted to stellar theory. First the constitution of individual stars is considered, and after that the interrelationship between the stars as we pass through groups of increasing complexity from binary stars and moving clusters, to the Milky Way system, globular clusters and extra-galactic nebulæ.

The introductory chapter on empirical astrophysical facts is exceedingly well written, and displays Jeans's admirable style in full force. There is one point, however, where I believe that a more detailed account would have been advantageous. This is in the representation of the Russell diagram, which has been the starting point as well as the stumbling stone of several cosmogonic theories in the short time which has elapsed since it was first given. That this diagram does not give an adequate picture of the abundance of stars of given spectral characteristics in space, is universally recognised. Thus it is known that dwarf stars outnumber the giants by hundreds or thousands, while the Russell diagram of all stars with known luminosity conveys the impression that giant stars predominate.

The diagram given by Jeans, however, involves other effects of observational selection as well. Thus, apart from the *B*-stars, which all belong to the moving clusters in Orion and Scorpius-Centaurus, the absolute magnitudes are derived exclusively by spectroscopic methods. Due to the difficulty of extending this method to stars of early type the diagram contains only *two* stars in the interval *A*0 to *A*5, while the total number of stars considered is 2100. This may be confronted with the fact that in the stellar system *every third or fourth star is an A-star*. It should further be noted that the high luminosity *F*- and *G*-stars, forming a conspicuous peak in the diagram, are selected *just* on account of high luminosity, since they are all Cepheids or pseudo-Cepheids, while the congestion of giant stars in the interval *K*1 to *K*6, according to the Mount Wilson report from which the diagram is reproduced, is partly due to imperfections in the underlying system of spectral classification. Moreover, all data derived from ordinary parallax work, as well as from the work on spectroscopic parallaxes after 1921, are neglected. It seems, on the whole, difficult to draw any trustworthy conclusions from this diagram about the relative abundance of giant stars of given luminosity but different spectral class.

As regards the internal constitution of the stars, it is clear from the outset that most conclusions must be highly conjectural in nature. It is therefore no wonder that hitherto it has been possible to enlist unanimous assent only for two main conclusions concerning conditions in the stellar interior, namely, that the temperature must average some millions of degrees, as a consequence of which the atoms must be largely dissociated into free electrons and very compact positive ions. Apart from these general results, opinions differ widely, and Jeans in particular has held and holds views which some other astrophysicists are reluctant to accept. In such circumstances it might have been a good plan, in writing a book for the general reader, to give the various ideas as impartially as possible, so as to give a fair impression of the present unsettled state of the subject. Jeans, however, has adopted the easier procedure of developing his own personal views, and in doing so he has succeeded in representing his ideas in the form of an imposing cosmogonic system.

A cornerstone in Jeans's cosmogony is the assumption that stellar substance is more like an incompressible liquid than a gas. It has not been possible thus far to make this idea plausible on the basis of atomic theory, and until this question is settled in a satisfactory manner the liquid star theory must be received with reserve. Jeans, however, does not consider the disagreement in question as serious, and believes that the criticism which may be adduced against the theory from

the side of atomic physics is more than counterbalanced by the success it experiences in astrophysics.

The suggestion in question was first brought forward in an investigation of the stability of a gaseous star. Making certain special assumptions concerning the mode of generation of energy in a star, Jeans found that gaseous stars are likely to be secularly unstable, and hence that stars which actually exist must involve substantial departures from the ideal gas laws. Following up this question further, Jeans believes he has found corroborative evidence for the same conclusion in the striking form of the particular Russell diagram which was commented upon earlier in this review. In Jeans's interpretation of this diagram the blank spaces correspond to states of the stellar matter in which particular electronic shells are in a process of disintegration. The blank lower left part of the diagram corresponds to the *K*-shell being in a disintegrating state, while the lack of giant *A* and *K* stars corresponds to a breaking down of the *L*- and *M*-shells respectively. As emphasised above, it would seem, however, that it is doubtful whether the empirical data in hand really warrant conclusions of this kind.

A further argument in favour of the liquid star theory is given by the surprisingly large number of close binaries found among early type stars. In fact, admitting the stars to be of uniform density and to rotate with a constant angular velocity, it follows from the classical researches of Poincaré, Darwin, Jeans, and others, that duplicity may, in the case of close binaries, be due to fission by rotational instability. In this way the liquid star theory is linked on to the main part of Jeans's cosmogony, which is based largely on the effect of rotation on stellar evolution. How this is carried out in detail is probably well known from his book, "Problems of Cosmogony and Stellar Dynamics," which was published nine years ago, and is largely reprinted in the present volume.

In the intervening time the theory has received an interesting addition in the discovery by Jeans two years ago that light pressure will exert a braking effect on a rotating star, such as to make its outer layers move with less angular velocity than the inner layers. Invoking this effect, Jeans has tried to explain some problems which hitherto have appeared to be intractable, such as Cepheid variability, or the equatorial acceleration of the sun. It is probably too early to say definitely whether the importance which Jeans attaches to this effect will be fully justified or not, as there are other agencies as well which may tend to produce a space variation of angular velocity in a rotating star. Thus, unless the heating sources in the star are distributed in a very special way, they must set up powerful convection currents which in turn must produce a variable angular velocity.

It is very difficult to arrive at a definite view of Jeans's theory of stellar constitution. I fear, however, that few theoretical astrophysicists will be able to share in Jeans's optimism concerning the future of the liquid star theory. It should be fully realised that atomic theory points the other way, and that most of the observational arguments brought forth in its support are open to alternative interpretations. Moreover, the considerations concerning stellar stability given by Jeans would seem to need considerable refinements before being accepted as final.

It is not possible to close this review without mentioning the last chapters on the great nebulæ, the galactic system, and the origin of the solar system. The chapter on nebulæ, in particular, is admirable with regard to style as well as carefully balanced poise of judgment on difficult points. In these days, when the island universe view of the spirals is so widely discussed, it is well to have brought to mind in an impartial manner the arguments in favour of this idea, as well as the serious difficulties opposing the view that an average spiral nebula is in all details comparable to the galaxy. In the chapter on variable stars Jeans brings forward some novel ideas regarding the origin of Cepheid and long-period variability based on the braking effect of light pressure in rotating stars. The ideas are evidently still in a nascent state, but even so they may serve the good purpose of breaking the deadlock encountered by the strict pulsation theory.

I have the feeling that the greatest value of this book lies in the vistas it opens up to workers in theoretical astrophysics. Intense work on special problems frequently narrows down the field of vision. But here is a book written by an active scientist whose mind is first of all focused on problems of the widest bearing. On the other hand, it cannot be overlooked that the style frequently has an apodictic turn which ill suits the intangible nature of the problems in hand, and it is no diversion to see the summary judgment with which the work of others is sometimes dismissed or ignored. The following example will indicate the seriousness of this remark: The energy

equation lying at the base of Jeans's investigation of pulsational stability is the obvious equivalent of v. Zeipel's theorem, which Jeans believed to have disproved some years ago. But I fail to find a frank recognition of v. Zeipel's work, and Eddington's interpretation of it, with its consequent importance for the problem of stellar rotation. Still more bewildering: at another place (p. 79) Jeans seems to adhere to his original statements! And instances like this might have been multiplied. This aloofness with which the work of other investigators is treated I consider to be an essential weakness of the book, and to make it less suited as a text-book for the uninitiated reader.

It was recognised long ago as a fundamental principle of literary criticism that in order to understand thoroughly a work of art it is necessary to be familiar with the mentality and history of its author. In the case of scientific literature this fact is mostly lost sight of, as it is expected that the odds and ends of the work will appear explicitly in the text and be justified by rigorous arguments. This, however, is more an abstract ideal than a reality. Anyway, in the case before us the personal views of the author pervade the book to such an extent that, besides being a work of science, it must be considered also as a work of art.

S. ROSSELAND.

Mantell of the Weald.

Gideon Algernon Mantell, LL.D., F.R.C.S., F.R.S., Surgeon and Geologist. By Sidney Spokes. Pp. xv + 263 + 7 plates. (London: John Bale, Sons and Danielsson, Ltd., 1927.) 12*s.* 6*d.* net.

GIDEON ALGERNON MANTELL is one of the group of medical men to whom early British geology was so greatly indebted. Their training in anatomy, which was then less restricted than at present to human anatomy, enabled them to interpret fossils and lay the foundations of British palæontology. Mantell, who came of an old Sussex family, had an extensive and successful practice at Lewes. In the intervals of his work he made the first important collection of fossils from the Weald, and is credited by Lyell with having established the freshwater origin of the Wealden formation. His own conclusions as to some of the fragmentary fossils were more correct than those of the best-trained anatomists of his day. Thus he discovered in the Weald, among other important fossils, some teeth and bones of the animal which he called the Iguanodon; he correctly identified it as a colossal herbivorous reptile, whereas Cuvier insisted that the remains were those of the hippopotamus and rhinoceros. Mantell also collected many of the fishes from the Chalk that were described by Agassiz. Sir John Flett, in his preface to the recent Geological Survey Memoir on the geology of the country near Hastings and Dungeness, remarks, "Special mention may be made of Gideon Mantell and W. H. Fitton, whose researches are among the classics of geology."

There has been no adequate account of Mantell's life or appreciation of his scientific work, though his name is gratefully remembered by many fossil collectors who owed much to the guidance of his "Medals of Creation," and his collection, now in the British Museum (Natural History), remains one of the most important contributions to Wealden geology. Mr. Spokes has done a valuable service by this biography of Mantell, especially by the publication of many letters to Benjamin Silliman of Yale, which give an illuminating account of contemporary geologists and throw interesting sidelights on early Victorian conditions. Thus he referred to the Prince Consort, whom he met several times at social-scientific functions and to whom he showed his microscope, as unpopular in society because the Prince preferred the company of men of intellect to that of dukes and marquises; and he deplored the inevitable deterioration of the Prince's fine mind by compulsory attendance at races and the influence of the turf.

Mantell's career was strenuous and his life in some respects unfortunate. Mr. Spokes is candid about Mantell's defects, and represents him as vain and querulous, and constantly aggrieved by what he regarded as intentional slights. His anger with Owen was not unjustified; but his comments on others are to his disadvantage. Thus Lyell, who was then laying the foundations of modern Kainozoic stratigraphy, visited Mantell at Clapham: Mantell remarked that "Lyell, as usual, was too absorbed in miocene, pliocene, plistocene (*sic*), etc., to care for any other 'scenes,'" and that "this tomfoolery would serve to amuse the geologists for six months." These statements show that Mantell was either blinded by what Mr. Spokes calls his jealous "obsession," or by his limited insight into the fundamental principles of geology. His happiest time was when in practice at Lewes; he made then his most important discoveries; he was entrusted by Murchison with the description of the famous "fossil fox of Oeningen"; he made the collection

which was his chief permanent contribution to science; he then gained among his fellow geologists the title of "the Wizard of the Weald"; while his reputation amongst the Sussex quarrymen is quoted by Lyell, who was directed to him as "a monstrous clever mon, as lived in Lewes, a doctor, who knowed all about them things, and got curosities out of the chalk-pits to make physic with."

This connexion of fossils and medicine was not felt in the communities where it might have helped Mantell. Mantell's growing ambitions led him to move from Lewes to Brighton, which was then a seat of the Court, and would, he hoped, provide a more aristocratic and lucrative practice. The medical men in Brighton were jealous of him, and the impression was spread around that no man could have gained such a scientific reputation without neglect of his patients and medical studies. Mantell's Brighton venture was a disastrous failure. His museum drew crowds of visitors; he was a success socially and as a popular scientific lecturer; but he had no patients, and after he had spent his savings he had to sell his collections to the British Museum for £4000. He settled in Clapham Common, and there was more successful financially. To avert the suspicion that he was not interested in medicine, he made many contributions to the medical journals, and his frequent expression of orthodox religious sentiments may have been partly issued in his professional interests. He afterwards moved to Pimlico, where he practised until his death.

Mantell's popular reputation was due to his skill as a lecturer and writer. His "Wonders of Geology" did much to interest his generation in the subject, and his "Medals of Creation" inspired many of the fossil collectors, from whom geology has enlisted a high proportion of its recruits. His permanent contributions to the geology of south-eastern England were, however, of first-rate importance, and the confirmation of the chief conclusions which he drew from the fragmentary reptilian remains of the Weald by the complete specimens discovered in Belgium and the United States show his sound anatomical insight. He was deeply hurt by being ignored on the foundation of the Palæontographical Society and wrote to Silliman: "I must be content to throw a few pebbles into the ocean of truth, and pass away from this scene of trial and suffering unremembered and unregretted save by a few valued friends." Mantell's place in British geology is far higher than he foresaw.

Power Engineering.

(1) *Applied Heat.* Adapted from "Der Wärmeingenieur" by Julius Oelschläger under the Editorship of Dr. H. Moss. Pp. x + 334. (London and Glasgow: Blackie and Son, Ltd., 1927.) 30*s.* net.

(2) *Les turbines à vapeur: traité à l'usage des ingénieurs, des techniciens et des éléves ingénieurs des écoles d'application.* Par Prof. Giuseppe Belluzzo. Traduit de l'Italien par Jean Chevrier. Deuxième édition entièrement refondue. Tome 1: *Théorie et calcul des turbines à vapeur.* Pp. xviii + 367 + 2 planches. 60 francs. Tome 2: *Les turbines à vapeur.* Pp. viii + 596 + 16 planches. 80 francs. (Paris: Gauthier-Villars et Cie, 1927.)

(3) *Applied Thermodynamics: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E., and A.M.I.Mech.E. Examinations in this subject.* By William Robinson. (Engineering Degree Series.) Pp. x + 564. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 18*s.* net.

(4) *Thermodynamics Applied to Engineering.* By Arthur F. Macconochie. Pp. xiv + 260 + 13 plates. (London: Longmans, Green and Co., Ltd., 1927.) 12*s.* 6*d.* net.

(5) *Les moteurs à courants alternatifs, les moteurs d'induction, les moteurs à collecteur: théorie, calcul, construction, applications.* Par Louis Lagron. (Nouvelle Encyclopédie Électromécanique, No. 2.) Pp. 429. (Paris: Albert Blanchard, 1927.) 25 francs.

(1) HEAT energy derived from the combustion of fuel is still the main source of mankind's energy supply, and it must be admitted that the world demand for energy increases year by year. It is important, therefore, that the utilisation of the available fuel should be conducted in the most efficient manner. In translating and adapting "Der Warmeingenieur," Dr. Moss has made available to English readers a most useful survey of the principal uses to which heat energy is applied, and one in which particular attention has been paid to the efficiency of the processes described. To make the work suitable for British engineers, Dr. Moss has found it necessary to effect considerable revision.

The book contains sections on natural and artifically prepared fuels, the principles of combustion, and their application to various forms of furnaces and burners, using all types of fuel. Chapters are included on the utilisation of heat for heating purposes and also for power purposes, but

in view of the literature otherwise available, the power section is relatively condensed. The concluding chapter deals with heat balance and energy measurements, and is a valuable feature. Another good feature of the book is the quantitative treatment of the chemical and heat reactions discussed.

The descriptive matter in the book is supplemented by ample data, and numerous tables and formulæ are provided. The book may be regarded to some extent as an encyclopædia of applied heat, which may be profitably consulted by engineers, metallurgists, and others desirous of improving the efficiencies of plants involving the application of heat. It is attractively arranged, the illustrations are excellent, and altogether we have much pleasure in welcoming its publication, which fills an obvious gap.

(2) Prof. Belluzzo's work on steam turbines, translated by M. Chevrier, is in two volumes. The first volume deals with the steam turbine from the theoretical and heat engine point of view ; the second volume is mainly reserved for the mechanical principles and details of construction. The work is a large scale one, reminding one to some extent of Prof. Stodola's well-known book.

In the first chapter of Vol. 1 a good deal of information is given about the heat properties of water and steam. As a reminder that nothing is final, this is a good thing, but we could not help feeling that post-War work on this subject is scarcely mentioned. Possibly the author feels that more information is necessary. Incidentally there is little mention of Callendar. The treatment of flow in nozzles follows standard lines, but the subject of supersaturation is only dealt with briefly. In the account of experimental researches on the flow of vapours, work done on the Continent is plentifully adduced, but valuable work done in Great Britain is almost ignored, and there is no reference to the labours of the Steam Nozzles Committee of the Institution of Mechanical Engineers. We should add, however, that we were attracted by some of the chapters, for example, on general principles of turbine calculations, on partial admission, and particularly on frictional losses.

In Vol. 2 we have a large mass of information which is well arranged, and, generally speaking, this half of the treatise appealed to us more than Vol. 1. The mechanical problems involved in drums, discs, whirling shafts, etc., are treated at some length, and the theory of the Michel bearing is given. There is also a good account of the application of turbines to marine work, and a short section on the application of turbines to locomotives. Although the constructions described refer mainly to Continental practice, this should be an attraction to English readers.

The illustrations and drawings are good, and some of the latter are dimensioned, but we deplore the absence (familiar in French books) of an index. The price is small for such a large work, and should tempt many engineers in Great Britain to buy it.

(3) Prof. Robinson's book on applied thermodynamics is intended as a text-book for engineering students and engineers studying heat engines, and is designed to cover the syllabuses in applied thermodynamics of certain well-known examinations. An important feature is the constant reference to laboratory work and modern research (with references), side by side with fundamental principles. Plenty of worked-out examples are given, and at the end of each chapter there is a good selection of examples, the answers to which are given.

In a book like this, covering such a wide range of subjects, Prof. Robinson has to exercise a large discretion as to the relative importance to be attached to individual subjects. Thus he gives an interesting chapter on internal combustion engines, extending to 145 pages. On the other hand, the chapters on nozzles and turbines are comparatively short. Possibly the latter chapters will be lengthened in later editions. We should also like to see a short reference to steam-condensing plant. Another minor criticism ; we failed to find any reference to exhaust calorimeters in the chapter on internal combustion engines. We regret this, as there is educational value in a good heat balance sheet, which may cause students to ask questions like : "How is piston friction to be treated ?"

The book is excellently produced, and we are quite sure that it will be a most useful and popular text-book for engineers.

(4) In his preface, Prof. Macconochie states that his purpose is to present the principles of engineering thermodynamics in the simplest fashion, to illustrate these principles by the best British and American practice, and in selecting examples for illustration to lay stress on recent developments likely to make a strong imaginative appeal. The book thus differs from many other text-books, in that whilst giving the main principles of heat engine theory, it only goes into the details of a comparatively few plants. The method has its advantages, particularly for the student who wants to get a fairly quick survey of the subject, and wants the

detailed work to be in the main stream of present-day progress. On the other hand, a writer using such a method is liable to omit material which other people may think important. However that may be, the practical examples chosen for illustration are interesting enough; they include, *inter alia*, turbine plants for mercury vapour and steam, the uniflow engine, the Westinghouse impulse reaction turbine, the two-stroke Diesel engine, the gas turbine, and the exhaust gas turbine.

The descriptive matter is accompanied by 13 photographic plates, which should help students to visualise the items dealt with. Among the tables of heat properties of vapours at the end of the book there is included one for mercury vapour. Two Mollier charts are also provided, one for ammonia, according to the U.S. Bureau of Standards, the other for steam. The latter goes up to 750 lb. per sq. in., and 800° F. Worked examples are given, but we think students would appreciate answers to the examples set for practice. Other problems are stated under the heading (somewhat unfamiliar to English engineering books) of "topics for discussion." The theoretical work is clear, and the whole book is very readable. We surmise that Prof. Macconochie, being at the University of Virginia, has naturally had in mind the needs of American students, but his book has many features of interest for British students and engineers.

(5) The great importance nowadays of alternating current (A.C.) motors is reflected in the increasing literature of the subject. M. Lagron's book (which unfortunately has no preface) deals with the theory, design, and applications of A.C. motors, but synchronous motors are only alluded to, as they are the subject of another volume of the Blanchard series. The greater part of the book is devoted to induction motors. In this connexion there are interesting chapters on losses and heat conduction. Afterwards, chapters are included dealing with the circle diagram, starting and speed control, monophase induction motors, and testing. A chapter on design is followed by another of 30 pages, in which the detailed design of a 45-h.p. 3-phase motor is gone into. Other chapters follow on construction and application of induction motors. Commutator motors are dealt with in a single chapter, and the concluding chapter deals with compensation in A.C. installations, and speed control of induction motors in cascade. There are four plates. The book contains a large amount of information, and can be highly recommended.

S. LEES.

Our Bookshelf.

Love's Creation: a Novel. By Marie Carmichael. Pp. iv + 416. (London: John Bale, Sons and Danielsson, Ltd., 1928.) 7*s*. 6*d*. net.

A DESIRE to have things 'both ways' is common enough, but still it is one which deserves censure rather than praise; and so it is that we approach this book with an unfavourable impression. We are told on the cover that it is by Marie Carmichael, and then a publisher's note informs us that the author is really Dr. Marie Stopes, while for shop-window display a publisher's label repeats the information. Dr. Stopes wishes to gain fame in a field other than those in which she has already made a reputation, but as she does not wish her readers to be misled by that reputation she chooses a pen-name which turns out to be no pen-name at all. The obvious question is, Why bother? And doubtless an answer just as obvious will suggest itself.

As to the contents of the book, it is a novel with a scientific atmosphere, partly obtained by much of the setting being in the University of London, and partly as it is the medium for the expression of certain scientific views. A young biologist, hitherto wrapped in his work, falls in love with and marries one of his students, whose sister marries a wealthy man who had been an old friend of her family before it was overtaken by poverty. The first of these marriages ends in swift tragedy, and the second proves not quite satisfactory owing to the lack of passion on the wife's part, but it too is dissolved by tragedy, and the hero eventually marries his dead wife's sister, who possesses the somewhat unusual name of Rose Amber, which is always given her in this double fashion. This name in some measure typifies the style of the book, as indeed also does the cover, which struck us at once as florid, and despite everything the impression remained.

The scientific portion is crystallised in a chapter which is headed by the warning that it does not carry on the story, and should only be read by those who *think* (*sic*). It consists in a popular exposition of the conception of the species as a greater unit of life, and is of course not new, and the manner in which it is put forward seems scarcely to merit the warning at the head of the chapter. We feel Dr. Stopes must do better than this if her literary name is to equal that she has won elsewhere.

W. P. K.

Introduction to Physiological Chemistry. By Prof. Meyer Bodansky. Pp. vii + 440. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 20*s*. net.

ALTHOUGH entitled an "Introduction to Physiological Chemistry," Prof. Bodansky's book contains considerably more material than might have been expected in an introduction to the subject. In fact, the work is suitable for the advanced student of biochemistry, not perhaps for the specialist, but for one who is reading biochemistry in addition to some other scientific subject. The work deals with the theoretical aspect of physiological

chemistry only: it contains numerous references to original papers and structural formulæ are freely used. Numerous tables are also included which are useful, but seem somewhat out of place in a book which is not meant for a work of reference.

The general plan of the book follows the usual lines: after a chapter on physical chemistry, the carbohydrates, proteins, and fats are each separately considered; chapters on digestion and absorption and the blood and lymph follow. Metabolism is dealt with in detail, and sections on the chemistry of the internal secretions and on nutrition follow: these accounts appear up-to-date, except in one or two instances, where a marked advance has taken place during the past year. We feel that the book will be of use to those who are revising the subject for an advanced examination and to those who wish to obtain some idea of modern trends in this branch of science.

Technical Drawing: a Manual for Evening Classes and Junior Technical Schools. By G. E. Draycott. Pp. vii + 232. (London: Oxford University Press, 1927.) 6*s.* net.

THIS is a very elementary text-book intended for the use of schoolboys just beginning the study of technical drawing. Well-informed students will be familiar with some of the earlier problems, but there are always a few who seem to evade any acquaintance with this subject during their school days, and it is probably for these that the simpler problems have been introduced.

In the later chapters the book deals with some of the properties of the circle and the ellipse, the areas of irregular figures, the projection and intersection of simple solids, the development of surfaces, pictorial projections, and simple machine drawing. The examples have been chosen to suit both engineering and building students, and are presented in such a way that the use of models (which are usually too expensive to be obtained in adequate quantities) is not of pressing importance. With the addition of two or three more complicated machine drawings, this book would cover a very satisfactory two years' course of the evening continuation school type.

It is unfortunate that Fig. 157, which illustrates a rather important principle of projection, should be so obscure. On the whole, however, Mr. Draycott has produced a useful small book plainly written and clearly illustrated.

A System of Qualitative Analysis for the Rare Elements. By Prof. Arthur A. Noyes and Prof. William C. Bray. Pp. xii + 536. (New York: The Macmillan Co., 1927.) 21*s.* net.

IN recent years the line of separation of the common from the rare elements has become very indistinct, and many substances which were until recently mere curiosities in some chemical laboratories have now found extensive industrial application. Many alloys, for example, which are in common use may now contain elements such as vanadium, tungsten, molybdenum, and cerium, whilst many other uses of the rarer elements are being discovered daily. The methods of testing for these elements have not been worked through systematically as has been the case with those in use for the common elements, and the present work is therefore of great interest and value. Many of the tests and separations are quite new, and one striking novelty is the extended use of perchloric acid in many of the separations.

The second half of the book contains much detailed information on the experiments made by the authors and their students on the subject, and there are useful references to original papers, although these have been carefully selected and are not large in number. This book cannot fail to be of service both to students and investigators and also to analysts.

River Engineering: Principles and Practice. By F. Johnstone-Taylor. (Lockwood's Manuals.) Pp. xiv + 119. (London: Crosby Lockwood and Son, 1927.) 4*s.* 6*d.* net.

THE control of the flow in natural streams has been practised for many centuries, and to-day, in nearly all parts of the civilised world, one of the most important of engineering problems is the control of the flow not only for power purposes, for irrigation, and for navigation, but also to prevent silting, the scouring of banks, and to prevent valuable land being spoiled by flooding. The small volume before us attempts to give only the rudiments of the subject, and it can scarcely be said that it does even that to the satisfaction of all those who may desire information upon certain branches of river engineering. The chapters on "Hydraulic Considerations" are, probably perforce, very incomplete, and will not in themselves be very helpful to the serious student. What may be called the constructional chapters, dealing with embankments, weirs, and control, and navigation are sketchy, and scarcely give sufficient information to help in the design of particular works, but they will be found of interest as an introduction to the subject, and practical hints of importance are given in the text.

Les larves et nymphes des Dytiscides, Hygrobiides et Haliplides. Par Dr. Henri Bertrand. (Encyclopédie entomologique, 10.) Pp. vi + 366 + 33 planches. (Paris: Paul Lechevalier, 1928.) 100 francs.

THIS very complete work deals with the immature stages and biology of the Dytiscidæ and related families of water beetles found in France. Out of a total of 94 species the larvæ of which are more or less known, 44 are studied afresh and in greater detail, and 33 others are described for the first time. The descriptions are very adequate and detailed, and are accompanied by 750 figures illustrating special structural features. Entomologists will find in this work a storehouse of information respecting the families concerned: useful tables are provided for the identification of the larvæ, while the discussions on the biology, adaptations, and phylogeny of the several groups should appeal to the special student of such subjects.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Colour of the Peacock's 'Eye.'

IN NATURE of May 26 I gave an account of the effect of ultra-violet radiation on the colours of the peacock's 'eye.' During the last month of sunny weather I have had a specimen in part exposed under quartz to full sunshine—in part screened. There is a definite effect, though much less marked than can be obtained by a few hours' exposure close to the quartz mercury lamp.

The effect is best seen using a glass mercury lamp as illuminant, with an angle of incidence of about 20° from the normal.

We then see that the dark colour of the 1st zone (centre) is completely discharged, while the 2nd zone shows blue on the exposed and green on the unexposed part.

Detailed examination of the colour changes under ultra-violet light and under sunshine has not yet been made.

Mr. F. Finn (NATURE, July 14) sees reason to think that the older museum specimens of peacocks show a perceptible colour change due to light. This is in accordance with the present observations.

RAYLEIGH.

Terling Place,
Chelmsford, Essex,
July 23.

The Constitution of Germanium.

MASS-SPECTRA of germanium were first photo-raphed five years ago by the method of accelerated nodo rays. The effects then obtained were feeble, ut sufficient to enable identification of its three rincipal isotopes, 70, 72, 74. Recently, thanks to he kindness of Prof. Dennis, of Cornell, I have been rovided with some volatile compounds of this lement suitable for use in the ordinary discharge ube, which so far is the only source giving beams f sufficient intensity for use with my new instru-ment.

Germanium tetraethyl was the first compound tried, and after one failure a better setting of the discharge tube was obtained, and the three expected lines appeared very clearly together with no less than five fainter new ones. This is the first success with a volatile metallic ethyl compound. This result was repeated, and afterwards similar results were obtained with the gaseous fluoride GeF_4. The spectra indicate that germanium has eight isotopes, 70 (c), 71 (g), 72 (b), 73 (d), 74 (a), 75 (e), 76 (f), 77 (h). The letter in brackets indicates the order of intensity. It seems very unlikely that any of these lines are due to hydrogen compounds, but the possibility cannot be entirely ruled out. Also the order of intensity is in doubt in the case of Ge^{76}, owing to the possibility of this being enhanced by the line of a compound (probably CS_2) often appearing faintly in the normal discharge. It will be noted that of all these mass numbers two only, 72, 73, are peculiar to germanium; the others all form isobaric pairs with the neighbouring elements zinc, gallium, arsenic, and selenium.

I should like to take this opportunity to point out an unfortunate printer's error in the table of atoms and packing fractions published in my Bakerian Lecture, and repeated in NATURE of Dec. 31, 1927. Mass number 81 belongs to bromine, not to krypton. Kr^{81} is a misprint for Br^{81}.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, July 21.

The Auroral Display of July 7.

A VERY unusual auroral display was observed from our north woods camp on Big Sauble Point on the eastern shore of Lake Michigan at 9.45 P.M. Central Standard Time, July 7.

At this time Vega has not quite reached the zenith and showed but faintly, so intense was the aurora. It radiated from a point about 8° south-west of Vega, which persisted for many minutes as an intense circular or oblong patch, presumably a streamer seen end-on. Radiating from this nearly to the horizon in all directions were other streamers, especially brilliant to the north-east. The dominant colour in the initial ten minutes was that of 5577·35 A., ascribed to oxygen in recent years. Later, the pink colour due to the nitrogen band systems was vivid enough in spots to suggest distant fires in the forest.

The brilliance of the display may be judged from the fact that it was possible to observe the motion of the second hand of a wrist watch and note the 5 s. division marks on the dial, and, as remarked above, only stars of mag. 0-mag. 1 were to be seen through it.

The entire absence of the characteristic arch (perhaps because it was directly overhead), combined with the aspect of streamers from directly below, is very rare at such southerly latitudes, 43° N., approximately. On the only other occasion on which we have witnessed a display similar to this, the general meteorological conditions were so unusual and so identical that we must needs mention them, although one would not expect any connexion between surface meteorology and the aurora, except the clearness that makes for visibility.

Both the displays mentioned have been associated *with fog* and high and steady wind. Over-water visibility here on the afternoon of July 7 was less than a mile and a half, and the evening was distinctly thick. The barometer was 29·1 in. and the temperature at the time of the observations 78° F., which is almost record temperature for this location. Indeed, were it not for the brilliance of the aurora on these occasions, one would attribute the low visibility of the brightest stars to fog and cloud.

The normal auroral displays are quite common here in clear cool autumn weather, but the association of two midsummer low latitude appearances with high temperature, humidity, and fog is so striking that we should appreciate any comment others may have about this, either through your columns or in correspondence.

HARVEY B. LEMON.

Ryerson Physical Laboratory,
University of Chicago.

Czechoslovakian Cytology.

MY "Structure and Development of the 'Living Matter,'" reviewed in NATURE of April 21, p. 610, discusses also the origin and fate of some components of animal and vegetable cells. Important new observations at variance with former interpretations based on Meves's work on the spermatogenesis of the guinea-pig, make a revision of the chapters on spermatid organisation indispensable. But Prof. Gatenby's paper on the Golgi apparatus and acrosome development require in their turn a revision, and this was given in "Living Matter." As its reviewer, Prof. Gatenby objects to several points referring to

the problem of the Golgi apparatus, and especially to the origin of the 'acrosome.' He tries to find fault with me for technical, personal, and formal reasons, but that is not the point here.

With regard to Prof. Gatenby's objections to the described origin and fate of the mitotic apparatus and to the origin of the acrosome in guinea-pig, he himself did not make any progress, but slipped into new mistakes, not understanding the true signification of the components in spermatids as described in my book and summarised in the following. The spermatids form after the second maturation division. The mitotic bodies of the prespermatids, not in the shape of 'idiozomes,' but as pedunculated bodies, transform into Golgi bodies and are soon ejected from the nuclear wall into the cytoplasm, where they disappear.

Another important process takes place in the nucleus of spermatids. By special processes the chromosomes transform into basi-chromatic particles and cast away the useless products, in shape of oxychromatic granules within the abundant nuclear enchylem and a certain number of nucleoli. The increased juice projects as a vacuole and is followed by the first two nucleoli, the substance of which dissolves and stiffens the vacuolic liquid. So the body called an 'acrosome' is formed. These nuclear processes produce a complete transformation of chromatin constitution. From the chromosomes of the earlier maturation generations all oxychromatic parts are ejected; there remains but a pure basi-chromatic substance in the shape of the smallest bodies, 'chromiols,' continuing into the mature sperms with solid protecting head cap on the front pole. Prof. Gatenby neglects this important biological fact and imputes to me the statement that "the acrosome is formed as a sort of coagulum from 'Karyochyme or nuclear liquid.'"

I fear that such untenable opinions will be repeated in future, if the pitfalls are not pointed out, to which such interpretations of the origin and signification of spermatids in *Cavia* are due. Many cytologists base their works on Meves's publication, without verifying its statements of spermatid origin. I undertook this ungrateful task, and the results will be published as an appendix to my book, with many drawings of mitotic bodies transforming into Golgi bodies. Prof. Gatenby would help to smooth the way for the solution of these important questions, if he would undertake the indispensable revision not only of Meves's, but also of his own accounts on the origin of spermatid structures and of their transition into mature sperms. F. VEJDOVSKÝ.

Prague, Czechoslovakia.

PROF. VEJDOVSKÝ writes in his criticism of my review, "The mitotic bodies of the prespermatids, not in the shape of 'idiosomes,' but as pedunculated bodies, transform into Golgi bodies and are soon ejected from the nuclear wall into the cytoplasm, where they disappear." *There is no transformation of any substance into Golgi bodies.* The latter are there in the fœtal gonad, and can be, and have been, traced right through spermatogenesis until they are sloughed off. Prof. Vejdovský is recommended to try the Kolatchev or Da Fano methods, or the neutral red method on fresh cells.

Since my review was printed in NATURE, Dr. Voinov has sent me a paper, "Le vacuome et l'appareil de Golgi dans les cellules genitales mâles de *Notonecta glauca* L." (*Arch. Zool. Expér.*, 1927), in which he shows that the acrosome bead is formed away from the nucleus and is only deposited on the latter in the late spermatid. The same thing was shown by me many years before in the spermatogenesis of *Paludina*. In Lepidoptera, each acroblast (Golgi element) secretes its own bead on the nuclear membrane. The nucleus is not directly concerned.

More recently Dr. Jan Hirschler has sent me two important papers which show that the acrosome bead may be stained bright red in neutral red *intra vitam, and can be followed during its formation away from the unstained nucleus.* The latter does not stain until the cell is moribund or dead. Hirschler has worked on a number of mammals, and his figures support Meves's interpretations (see especially his most recent paper in the *Zeit. f. Zellf. u. mikr. Anat.*, p. 205, Abb. 1, p. 205, Abb. 2, for *Cavia corbaya*).

Nothing published before Prof. Vejdovský's "Living Matter," or since, supports his views. I ask him to study Hirschler's work, which is the most recent published, and has been carried out on fresh cells stained in Janus green and neutral red. This work, and that of Monné, also demonstrates that Parat's neutral red staining vacuome is not the same structure as stains black in Da Fano, Cajal, or Golgi's methods.

With reference to the main part of Dr. Vejdovský's letter, his nomenclature, like that in some parts of "Living Matter," makes it difficult to understand exactly what he means. It is certain that he wishes to declare that the acrosome is in some way of intra-nuclear origin. If there are subsidiary parts of this theme which I have misunderstood, I am sorry. I trust that in his promised appendix he will pay some attention to the work of Hirschler, Monné, Bowen, Nath, Hyman, Voinov, and to my own studies on *Paludina*, *Saccocirrus*, and *Peripatus*.

Finally, while there is little in Prof. Vejdovský's account of mammalian spermatogenesis and acrosome formation with which I can agree, his work has provided a stimulus, and will undoubtedly form the basis of much further work on the problems with which he has so long been prominently associated.

J. BRONTË GATENBY.

Trinity College,
Dublin, July 12.

The Movement of Sap in Plants.

AFTER the conclusion of his recent lecture at the University of Vienna, Sir J. C. Bose was kind enough to lend me his instruments for the repetition of some of his more important experiments in the Institute of Plant Physiology of the University. As this is the first time that his experiments have been successfully repeated in a European laboratory, the following results which I obtained will be of interest to readers of NATURE.

(1) *The Infinitesimal Contraction Recorder.*—This ingenious apparatus records the cellular contraction in the interior of the plant under external stimulation. The principle of the instrument is extremely simple: the extreme delicacy of the apparatus bears testimony to the extraordinary skill of the Indian mechanicians trained at the Bose Institute. The stem or other organ of a plant is placed between a fixed and a movable primary lever. The diametric contraction of the plant under stimulation is indicated by the movement of this primary lever, which is further magnified by optical means, the total magnification produced being a million times. The indication of the instrument is not affected by mechanical disturbances.

(2) *Sensitiveness of Ordinary Plants.*—An extremely feeble electric shock was sent through me and the plant, both being placed in the same electric circuit. The plant responded visibly by a contraction to a

shock which was below the threshold of my perception. With a stronger shock the cellular contraction was more intense; under excessively strong shocks the contractile spasm became very violent; after a short time the tissue ceased to respond, being effectively killed by the electric discharge. It is quite easy to show that the cortical cells in every section of the stem and of the leaf-joint are fully sensitive, proving a continuity of contractile cortex throughout the length of the plant. A wave of peristaltic contraction may thus sweep onward from the point of stimulation.

(3) *The Movement of Sap.*—The following striking experiment affords conclusive proof that the movement of sap is essentially not a physical but a physiological process. A cut piece of stem of *Antirrhinum* with a pair of opposite leaves is suitably fixed at the cut end in a piece of sponge. Under excessive drought the leaves fall down, become crumpled up and are wilted. A few drops of cardiac stimulant—dilute solution of camphor—applied on the sponge bring about a striking transformation. The drooped leaves are quickly revived; they rear themselves up with great rapidity, and become fully erect in the course of 2-3 min.

(4) *Active Cellular Pulsation in Propulsion of Sap.*—The pumping of sap by the propulsive tissue is early demonstrated by the optical sphygmograph. he flow of sap along the stem is observed to consist a series of pulsations. The pulsatory activity is eatly increased by drugs which enhance cardiac tivity in the animal; it is enfeebled or arrested by pressing agents. Extracts from certain Indian ants have a potent influence on the propulsive tivity of the plant and the cardiac activity of the imal. This aspect of the investigation has roused nsiderable interest in the Medical Faculty of Vienna.

(5) *Movement of Sap in Sealed Stems.*—It has been ought that the movement of sap is essentially due push from below by root-pressure and suction from bove by transpiring leaves. The fact that there is n inherent activity in the stem itself, independent f those in the terminal organs, is clearly demonstrated y experiments on an isolated stem covered with npermeable varnish. The sap can now be made to ow either upwards or downwards, according to ifferential stimulation. The law of directive movement of sap is that it moves from the stimulated the unstimulated or depressed region. The cellular echanism is highly sensitive, being automatically djusted for subserving the well-being of the plant. local depression or stimulation makes the sap ush towards the depressed or away from the overtimulated region. It is in this way that chemical ubstances stored in one region are conveyed to disant parts. By this hydraulic mechanism the plant as whole becomes an organised unity.

I have seen Sir J. C. Bose carry out the experiments described above, and can confirm, since I have repeated some of them with Sir J. C. Bose's apparatus, that the results are as he has described.

H. MOLISCH.

Pflanzenphysiolog. Institut,
Wien, I., Universität, June 20.

Polarisation of Scattered Light-quanta.

IT is well known from the work of Barkla, Compton, and others that X-rays scattered through 90° by matter are completely polarised, irrespective of whether the electron remains bound or suffers ejection from the atom as the result of the impact of the quantum upon it. The recent discovery of a new type of light scattering with altered frequency (NATURE, May 5, p. 711) makes it of importance to ascertain whether a light-quantum which is scattered with diminished energy is less perfectly polarised than in the ordinary case.

We have investigated this question with several liquids by analysing the scattered light with a spectrograph having a suitably orientated Nicol placed in front of its slit. The results obtained are extraordinarily interesting, as will be seen from Fig. 1. Fig. 1 (*b*) represents the spectrum of the incident light from the mercury arc. Fig. 1 (*a*) represents the spectrum of the scattered light from liquid benzene, the upper and lower halves of the spectrogram corresponding respectively to the two principal directions of vibration. It is seen that some of the new lines which appear only in the scattered spectrum are actually polarised much more completely than the lines present in the incident spectrum. Further, the degree of polarisation varies greatly from line to line, some of the new lines being strongly polarised, others only very partially so. So large are the differences in polarisation that the relative intensity of the lines is quite different in the upper and lower halves of the spectrogram. In the case of amyl alcohol as well

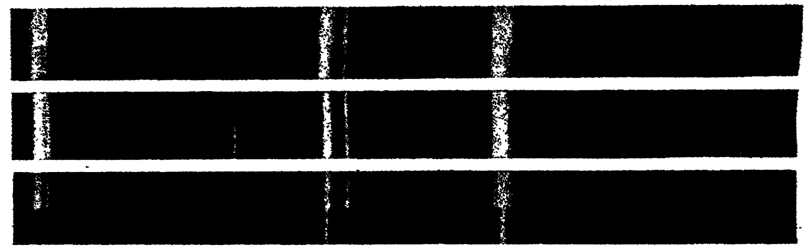
(*a*)
(*b*)
(*c*)

FIG. 1.

(Fig. 1 (*c*)) the new lines in the scattered spectrum are polarised to varying extents, and the continuous radiation appearing in it is also partially polarised.

The strong polarisation of the modified light scattering is intelligible in view of the analogy with the Compton effect. Since the different modified lines represent different electronic transitions induced in the molecule by the incident radiation, the varying extents of their polarisation may be interpreted as due to the optical anisotropy of the molecule being very different for different types of deformation. That some of the intense modified lines are polarised even more strongly than the unmodified lines need not occasion surprise, if we remember that the classical light scattering in a liquid is much less perfectly polarised than the scattering by the molecules of the corresponding vapour. If we assume that the modified scattering is an incoherent type of radiation, we should expect its intensity to be proportional to the density of the fluid, and its polarisation to be comparable with that of the classical scattering in the corresponding *vapour* (not liquid). These expectations appear to be not very far from the truth.

C. V. RAMAN.
K. S. KRISHNAN.

210 Bowbazar Street,
Calcutta, June 14.

Molecular Measurements by Optical Lever.

FOLLOWING preliminary experiments performed more than two years ago, I have now arranged an optical lever of precision, giving very large magnification, and applied it to test (*a*) the accuracy with which a steel-to-steel contact will return after separation, and (*b*) whether the thickness of a mica sheet can be

detected as varying in multiples of the molecular 'length.'

The lever has an effective length of 0·0337 cm., and consists of a vertical piece of thin steel sheet (about 1 cm. × 1 cm.) to the lower edge of which three $\frac{1}{32}$ inch diameter ball-bearings were soldered, not quite in a line. The outer ball-bearings rest on the two poles of a permanent horse-shoe magnet, enabling the lever to be conveniently maintained in equilibrium (even though the central ball is only $\frac{1}{3}$ mm. out of line with the outer ones). The beam of light, after reflection from the mirror, forms an image (of an illuminated slit) at about 123 cm. from the mirror. This image is viewed through a Hilger travelling microscope graduated to $\frac{1}{100}$ mm. (read to $\frac{1}{1000}$ mm. by estimation). A setting can be made considerably more accurately than to the half-width of the central bright diffraction band. (See Dr. Burton, *Phil. Mag.*, 1912.) The average of ten consecutive microscope settings had a probable error of about $\frac{1}{5000}$ mm.

The results of the tests on a steel-to-steel contact show that contact can be repeated (when care is taken) to approximately $\frac{1}{3} \times 10^{-7}$ cm. (These tests have not yet been fully analysed.)

A thin sheet of mica was then placed under the central leg of the lever. On tilting the lever and letting it return on to the mica, changes in reading were observed without moving the mica by hand. Three sets of experiments were performed. Ten or more microscope settings were made between one move of the lever and the next, and successive mean values were subtracted. (In two of the three sets of observations a gradual drift of the readings had to be allowed for.) The 32 differences so obtained ranged from 0·0005 mm. to 0·45 mm. (The differences appear to have a probable error of the order $\frac{1}{5000}$ mm.) Of these, the 20 readings below 0·040 mm. were analysed for a periodicity between 0·004 mm. and 0·020 mm.

A periodicity of about 0·00745 mm. was found, its presence not being accountable for by 'chance.' This corresponds to an integral change in the thickness of the mica of about

$$\frac{0 \cdot 000745 \times 0 \cdot 0337}{2 \times 123} = 10 \cdot 2 \times 10^{-8} \text{ cm.}$$

(The mica used was white and biaxal, but has not been definitely identified.)

This value may be compared with that obtained by C. Mauguin by an X-ray method (*Comptes rendus*, p. 288, July 25, 1927) of $9 \cdot 95 \times 10^{-8}$ cm. for muscovite or white mica ($Al_3Si_3KH_2O_{12}$).

The 12 larger readings not included in the above analysis do not contradict the above estimate, but do not give any measurable evidence for the periodicity. It is not difficult to see reasons why this may be the case.

It is hoped that a fuller account of these experiments may be prepared for publication shortly.

W. N. BOND.

Physics Department,
University of Reading,
June 26.

Quality of Soil in Relation to Food and Timber Supply.

I HAVE read with great interest the lucid letter by Mr. Forbes under the above heading which appeared in NATURE of July 14, p. 54. When replying to Mr. Hiley's letter in NATURE of June 2, I did not rule out the importance of the production of meat as one source of the food supplies in Great Britain, as the last sentence of my reply bears witness. I am in agreement with Mr. Forbes when he says that many of the forests producing commercial timber in Europe are growing on soils which are by no means poor. But in many cases these soils would become poor and degraded if the forests were cut down and the land left exposed for a long period. Instances are known to me in Europe where magnificent hardwood forests are occupying a light soil of low quality, as is evidenced by the agricultural land in their vicinity. The latter areas once formed part of these forests and produced as fine a timber. It would now take a rotation at least before they could be brought into a condition to produce the same quality timber. It is known that areas which were disforested as late as the early years of last century now consist of a very poor agricultural soil.

Those possessing a first-hand knowledge of the disforestation which has proceeded apace in parts of the British Empire overseas are well aware of numberless cases where the hopes based on the agricultural development, to promote which the areas were disforested, resulted in disappointment. The land, with the long built-up humus layer and resulting forest soil, was a good forest land; but once exposed soon became worthless for agriculture.

Mr. Forbes says, "a country cannot both have its cake and eat it." We ate our 'cake' when our ancestors, several centuries ago, cut the forests, both from the real agricultural lands and from the true forest ones. The latter have since been woefully mismanaged, and Mr. Forbes rightly fears that they will not produce commercial timber. The same applies to many of the poorer degraded grazing grounds. But this is no argument justifying the forester selecting agricultural land, however poor from the agricultural point of view at the present day, and placing it under tree crops. I repeat that the money, in a densely populated country like Britain, would be more correctly spent in improving the food-producing lands, whether crop or meat ones. In parts of Europe the improvement of the grazing lands is a recognised part of the forest officer's duties; it has been brought to a high level and merits a close study by foresters in Great Britain.

As regards the production of timber, it may be suggested that the State forester's real business in Britain is to set to work to bring back the poor degraded forest soils to a state in which, in a future rotation they will be able to produce commercial timber—a heart-breaking and thankless task for the present and several future generations of foresters, be it admitted. But if we are considering the economic position from its broadest viewpoint, in the interests of the nation in the future, a century or two hence, this, from the professional point of view, is the present chief duty of the State forester—and a hard one.

THE WRITER OF THE ARTICLE.

Overpotentials produced by Films of Hydrogen less than one Molecule thick.

IN the course of recent work in the Physical Laboratory of this University on hydrogen overpotential at a mercury cathode, large changes of electrode potential were found to take place, and considerable overpotential was produced with depositions of hydrogen corresponding to very much less than a monomolecular layer. It was felt that these observations were of considerable interest, as they showed that, for the overpotential so obtained, any theory requiring gas in bulk (such as a surface tension theory, or one requiring a continuous film offering resistance to the current) would be untenable.

We have since had the opportunity of reading some unpublished work by Mr. F. P. Bowden carried out in the Physical Chemistry Laboratory in Cambridge with Dr. E. K. Rideal. He arrives at the same con-

clusions, using a rather different method. Although Bowden's work is very much more comprehensive and complete than our own, we feel that a brief account of our results obtained under different conditions may be thought of interest as confirming his. The results are also interesting as indicating the nature of residual current.

In our work a pool of carefully purified mercury of about 7 sq. cm. area was used as cathode, the electrolyte being normal sulphuric acid. Air was dispelled from the cell by boiling and cooling under a stream of hydrogen, obtained by electrolysis from a portion of the same solution. A very thorough elimination of oxygen was absolutely essential. A current of the order of 10^{-4} amp. per sq. cm. of cathode surface was then passed to the mercury as cathode for a few minutes to deposit any stray mercury ions that might be in the solution. After standing for a minute or two the electrode was positive to the saturated calomel electrode, that is, its potential was more positive than the hydrogen electrode by more than 0·3 volt. On passing a current of the order of 1 micro-amp. per sq. cm. to the mercury as cathode, the rise of potential could be followed easily with a potentiometer. Overpotentials of 0·3 or 0·4 volt were produced (that is, the electrode potential changed by 0·6 or 0·7 volt) when less than one-eighth of a monomolecular layer had been deposited. From the nature of the time rise curves there were indications of oxygen being incompletely eliminated, and it seems probable from this and other observations that a still smaller deposition would give rise to an overpotential under ideal experimental conditions.

Unless the greatest care was taken to remove oxygen, no overpotential was produced with currents so small as this; instead, the familiar effect of residual current was observed at a potential more positive than that of the hydrogen electrode. This was evidently due to depolarisation by dissolved air.

A. L. McAULAY.
D. P. MELLOR.

Physics Laboratory,
University of Tasmania.

Correlation.

IN NATURE, June 2, under the heading "Correlation," Mr. Dufton refers to a graphic method for the determination of a linear function, from 14 points, which must be taken as having the same weight, in the absence of any information as to their respective worth.

It is difficult to follow Mr. Dufton's method. He refers to the 'median of X,' without defining what is meant by this. The figure shows a vertical dotted line, likewise unexplained, except that there are seven plotted points on each side. The line seems then to have been drawn at random, except that the same number of points is found on either side. But any person accustomed to graph work can see at once that the line is wrongly placed: the points on one side are as a whole farther from it than the points on the other side; in other words, the line does not pass at all *evenly* among the points.

Readers of NATURE may be interested to know that while there is no need to have recourse to the method of least squares in such a simple case, yet there is a method which enables one to ascertain fairly accurately the position of the graph. It is Cauchy's method, which yields in a few minutes, in this case, the equation $y = 9{\cdot}25 - 0{\cdot}75x$. This line passes through two of the given points ($y = 7$, $x = 3$, and $y = 1$, $x = 11$), and it satisfies also Mr. Dufton's criterion, as it has six points on each side, but a glance shows that it is a far better solution, as it is possible to 'pair off' the points so that the points of each pair are very nearly symmetrically distributed with respect to the graph, which is not possible with the graph given by Mr. Dufton. The points below the line are, except one, much nearer than the points situated above the line, as can be verified by drawing the line representing the above equation.

Cauchy's method appears to be practically unknown among physicists and engineers. It applies to functions of a higher degree as well. A description of this method for the determination of the constants of empirical formula will be found in *The Engineer* for Sept. 13, 1912, p. 267, with applications to functions of the first, second, and third degree, completely worked out.

It is easy to go astray when drawing a line to suit points so erratically distributed as those in the example selected by Mr. Dufton, and a method which enables one to obtain the equation without fumbling is invaluable in such cases.

M. E. J. GHEURY DE BRAY.

40 Westmount Road, Eltham Park,
London, S.E., June 24.

The Arc and Spark Spectra of the Halogens.

THE issue of NATURE for June 30, 1928, contains a very interesting note from Dr. Laporte on the arc spectrum of chlorine. The reader will, however, be surprised to find it stated there that the separation of the chlorine lines into arc and spark lines has not hitherto been accomplished, reference being made to Kayser's "Handbuch," which lists the two types of lines together indiscriminately.

So long ago as 1915, Nelthorpe showed (*Astrophysical Journal*, vol. 41, p. 16) that the two sets of lines are quite well distinguishable by their different behaviour in a condensed discharge. More recently L. and E. Bloch (*Annales de Physique*, vol. 7, p. 206, and vol. 8, p. 397) have given a complete separation of the arc and spark spectra, as well as a division of the latter into spectra of the first and second orders. This division has been effected not only for chlorine, but also for bromine and iodine (*Comptes rendus*, vol. 180, p. 1740; 1925; and vol. 184, p. 193; 1927). We may add that in the meantime a third order spark spectrum of the latter metalloid has been found, well developed in the ultra-violet. The data have been examined, and have already led us to a recognition of some fundamental terms in the spectrum Br II.

LEON BLOCH.
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The Green Flash.

IN some localities the green flash at sunset is by no means so rare a phenomenon as might be inferred from Prof. Wood's experience on the Atlantic Ocean and from the letters of some other correspondents of NATURE. Here in Southern California in the last two years, I have seen the flash many times as the sun has set over the Pacific Ocean, or over the Santa Monica Mountains a few miles west of our residence. On one occasion Mrs. Barnett and I both saw the flash as the sun sank behind a dense cloud; and at least once I have seen the colour of the flash change distinctly from green to blue or blue-green before disappearance.

S. J. BARNETT.

University of California at Los Angeles and
California Institute of Technology,
May 30.

Cancer Problems.

THE International Conference on Cancer arranged by the British Empire Cancer Campaign was held in London on July 16–20 The mornings were devoted to sectional meetings and discussions at the house of the Royal Society of Medicine and at the College of Nursing next door; in the afternoons visits were paid to various hospitals and other institutions, where more practical demonstrations were given. More than a hundred delegates came from the British Empire, most European countries, the United States, China, and Japan, and more than two hundred from British institutions. The whole occasion went off very well. It is impossible to give any complete account of the proceedings: we deal only with a few topics of more general interest.

More than twenty years ago, Bashford and Murray showed that a malignant tumour of epithelium (carcinoma), propagated by being transplanted from mouse to mouse, might occasionally cause the normal connective tissue in contact with it to take on the characters of a malignant tumour and become a sarcoma with the characteristic capacity for indefinite and independent growth. It seemed evident that some substance must pass out from the carcinoma cells to influence the adjacent connective tissue cells. All attempts, however, to demonstrate such a substance by inoculating extracts of carcinomata and similar experiments were uniformly unsuccessful until, in 1912, Rous and Murphy found several sarcomata of fowls in which this carcinogenic substance was so stable that it could be extracted and studied at leisure. A number of similar tumours have since been found in fowls by other observers. With most tumours transmission from animal to animal can be effected only by the transference of live cells; these Rous tumours can be transmitted by ground-up cells, dried cells, and by extracts which have been filtered through porcelain so that they contain no recognisable remains of cells at all.

The activity of these extracts, in which the active agent has a limited stability and persistence, in inducing malignant tumours in fresh fowls is conditioned by a number of factors which are not clearly defined and about which there has been a good deal of difference of opinion and experience in recent years, since Gye revived interest in the matter by his fresh interpretation. Acidity, alkalinity, mechanical and chemical injury, etc., have been found to influence the result; particular interest attaches to the action of extracts of other tissues which, it appears, may have either a favourable or an inhibitory effect.

Whether the active agent in these extracts can fairly be called a virus depends to a considerable extent on what 'virus' means. If it connotes an organism capable of independent life and multiplication of the same order as is enjoyed by most ordinary bacteria, the evidence is distinctly against the Rous tumour being a 'virus' disease, and at the Conference, Dr. J. B. Murphy, of New York, brought forward further observations which make it scarcely possible to believe in a 'virus' interpretation of the facts. He showed that by differential precipitation of Rous tumour extracts by electrodialysis (or simply by acidifying the extracts) the whole of the active agent could be separated. It appears to be mainly or wholly a nucleoproteid and can be dissolved and reprecipitated repeatedly without losing its activity: it still produces tumours in fowls with great regularity, and can also be found in the blood of fowls with developed tumours.

The isolation of this active agent is the logical sequel to Bashford and Murray's experiments. It has been possible because these particular fowl tumours contain the agent in such a form that it will tolerate experimental manipulation.

Such experiments involve the use of materials derived from an existing cancer: they may explain how a tumour involves neighbouring cells in its mad career, but they do not necessarily throw any light on how a tumour originates *de novo*. All the available evidence is against the idea that the active agent spreads from one individual to another, and it is in connexion with the popular idea that cancer may be 'catching' that the use of the word 'virus' is practically undesirable. The outstanding piece of progress in respect of our knowledge of the origin of fresh cancers, which was dealt with in a variety of ways at the Conference, is the cumulative realisation of the importance of chronic irritation and injury and the progressive implication of the products of burnt coal as the most effective irritants known.

Clinically and epidemiologically, instances of the relation have multiplied steadily during the last fifty years: the kangri cancers of the belly wall in Kashmir, the cancers arising in X-ray burns, and the appearance of mule-spinners' cancer in Lancashire, are practically human experiments on a big scale. The recent increase in cancer of the lung was the subject of a special discussion at the Congress, and everyone looked for the explanation in some new sort of irritant—the influenza of 1918–19, tarred roads, motor fumes and oil, cigarette smoking, and what not. It is becoming easier to understand why the great majority of human cancers occur in a limited number of places in the body—uterus, breast, lips and mouth, stomach, large intestine and rectum.

While, therefore, the importance of irritation was fully recognised, the influence of the qualities of the irritated tissues (*i.e.* of the constitutional factor) was illustrated by Miss Maude Slye's account of her mice in Chicago. By selective inbreeding she has on one hand so intensified the tendency to develop cancer in a given environment, and on the other hand so eliminated it, that she has two groups of animals in which almost all, and scarcely any respectively, develop tumours. By a unique piece of devoted work she has shown that the incidence of fresh cancers is partly dependent on heritable

qualities. Mating which is selective *qua* cancer is at present not practised by man, and in human experience heredity is negligible. But with the same inducement in the way of irritation, some people are no doubt more liable to develop tumours than others.

No one succeeded clearly in reproducing this experience about irritation experimentally until, in 1914, Yamagiwa and Ichikawa showed that cancers of the skin could be produced fairly regularly by the patient and persistent application of tar to mice. In other animals it is more difficult, and we owe one great advance in our knowledge of cancer to this peculiar susceptibility of mice just as we owe another to the exaggeration of the active agent by the Rous tumours. General principles are often revealed by special instances.

This great discovery is important in many ways. It put into the hands of experimentors a method of producing new cancers at will. Using it to test the carcinogenic properties of various irritants, they have found that coal products have an efficacy which seems to be unique: tar and soot and mineral oils and various preparations made from them all contain something (which has not yet been precisely identified) which causes cancer more or less readily in mice. We have here the experimental verification of the association recognised long ago in chimney-sweep's cancer of the scrotum, and in such statistico-geographical inquiries as those of Mr. C. E. Green, who clearly worked out the connexion between cancer and burnt coal with a layman's enthusiasm and common sense. The case against soot has come to be a very strong one.

If cancer can be produced by irritation, it is reasonable to assume that the active agent has originated in the irritated tissues. It is known from a variety of evidence that the products of the autodigestion which dead cells undergo in the body stimulate the growth of cells, and that the tissues of embryos are particularly rich in these growth-promoting substances. The implantation of embryonic cells into the body of an animal of the same species does not give rise to a tumour. But, as Carrel showed, a positive result may occasionally be obtained if to the mashed-up embryo a little arsenic or indol is added, which also by itself would be ineffective. The next step in this sequence also came from Dr. Murphy at the Conference. He announced that by treating the testicles of normal fowls by the same technique that resulted in the separation of the active agent from fowl tumours, he had obtained a preparation which caused malignant tumours when inoculated into fowls. Dr. Leitch also stated that he had found that extracts of pancreas were singularly effective in aiding the action of tumour extracts, and that on one occasion he had succeeded in producing a tumour with an extract of normal pancreas by itself.

These remarkable results of course require confirmation, but they are not unexpected, and follow naturally from our previous knowledge. They suggest that tar, for example, unmasks an active agent which is normally present in an ineffective form or is held in check by the resistance of the tissues. It may be that the active agent arises (or is let loose in an effective form) in the body as the result of cell injury and degeneration much more often than we commonly suppose, and that it fails to give rise to an obvious cancer either because ancillary substances are absent or because inhibitory substances or processes are present. The practical problem of cancer prevention may perhaps be more fruitfully phrased as, Why does not everybody have cancer? rather than as, Why do some people have cancer?

The only other point requiring mention which came out clearly at the Congress is the substantial practical advance which has been made in treatment by radium. By dispersing the radium throughout the substance of the tumour and in its neighbourhood, and by using small doses for long times rather than large doses for short times, there is no doubt that a good many cases of cancer can be cured, and most material alleviation can be secured in cases which have progressed too far to stop. At the same time, there is no justification for any talk about surgery being eliminated. The present price of radium seems to need some justification. How it operates is still not understood. The radiations may act better than other differential killing agents because of their nature or because they impinge continually upon the tissues without being too concentrated at their point of origin: like other harmful agents, they kill the cells of tumours more easily than those of normal tissues.

The International Research Council.

THE fourth General Assembly of the International Research Council was held at Brussels on Friday, July 13. M. Picard, president of the Council, presided, and the meeting was attended by delegates from most of the countries adhering to the Council. A meeting of the executive committee had been held on the previous Wednesday. The report of the general secretary, Sir Arthur Schuster, was presented, and a number of resolutions adopted. The report showed that at the conclusion of the extraordinary general meeting in June 1926, the secretary had taken steps to inform the nations concerned of the unanimous decision to invite Germany, Austria, Hungary, and Bulgaria to join the Council and the Unions attached to it.

Austria, Hungary, and Bulgaria each possess an Academy, which is the recognised authority in scientific matters, and invitations were sent to each of these; at the same time their diplomatic representatives in London were informed. In the case of Germany there is no single representative Academy. The Foreign Office in London was consulted, and by its advice an invitation to join was

they are designed: for timber and fuel, those desirable for physical and climatic reasons, fodder and grazing, and those more suitable for cultivation. One of the most promising lines would be the handing over of certain tracts adjoining villages for control by them under certain restrictions.

The chapter on irrigation enumerates the projects at present being developed in the different provinces. For the rest, the Irrigation Committee of 1903 is stated to have treated all aspects in such a comprehensive manner that no further inquiry was considered necessary.

Communications and marketing are appropriately considered together in Chapter xi. The opening up of the country has had the effect of introducing money crops, that is, those for sale in place of direct consumption. Evidence shows, however, that there has been a deterioration in the character of the roads during recent years; and on this account the Government of India has instituted a Road Development Committee. But this appears to deal primarily with the arterial roads, and the Commission again urges the importance of those leading to the villages, seeing in them a ready means of stimulating village thought by bringing them into closer connexion with the towns.

Although the Agricultural Department has done much to improve the quality and increase the quantity of the cultivator's products, comparatively little seems to have been done to enable the producer to get the full advantage of this. Markets are numerous in India: for example, in Bihar and Orissa there are 432 principal and 2624 minor ones, and much information has been brought together and collated by the Commission. It suggests, however, that a regular survey of markets should be taken in hand, and that an expert marketing officer should be attached to each provincial agricultural department. A further attempt should also be made to standardise the weights and measures throughout India.

Under finance, land mortgages are somewhat fully considered, and the importance of facilitating redemption within a reasonable period, say twenty years, is insisted on. The Commission resolves that "the greatest hope for the salvation of the rural masses from their crushing burden of debt lies in the growth and spread of a healthy and well-organised co-operative movement, and local governments should, therefore, give that movement all the encouragement possible."

Co-operation is very fully discussed in Chapter xiii., and the remarkable advance made in recent times is indicated by a table showing a quadrupling of credit societies during the past eleven years—from 16,690 to 65,101, with a like rise in the number of members and a somewhat greater increase in capital. "Where the co-operative movement is strongly established, there has been a general lowering of the rate of interest charged by moneylenders; the hold of the moneylender has been loosened, with the result that a marked change has been brought about in the outlook of the people."

The formation of non-credit societies (such as for seed, implements, manures, cattle insurance) is naturally a later growth; they are a much more difficult proposition, because of the need of business capacity and expert advice. The figures given in the same table for the past eleven years show an increase from 96 to 2133, with a much greater rise in the number of members and a still greater rate of increase in the amount of capital involved. The Commission records its opinion that single purpose societies are to be preferred to multiple purpose societies.

In Chapter xiv. the Commission returns to "The Village," and deals comprehensively with sanitary and medical matters, and especially with the various agencies, official and non-official, for the improvement of the amenities of village life. This is an exceedingly interesting and inspiring chapter, and the members of the Commission evidently have the matter very much at heart. They take the long view and enumerate, at length, the various possible directions in which they consider that a betterment can be brought about: they recognise that progress must be slow, and can only be effected through the will of the people themselves, and that a public opinion must be created among them.

Those who know their India may perhaps feel that the view is so long that it sometimes tends to become visionary. We read that in the latter days "the old men shall dream dreams and the young men shall see visions"; and it is therefore appropriate that the Commission should turn for help to the universities, who "have at once an obligation and a great opportunity to assist in the work of rural development on both its economic and educative sides." Leadership is in fact required, and must come from outside. An interesting local solution is described from one of the districts in the Punjab, where young men are carefully trained as 'guides,' and each is posted to a number of villages to act as propagandist for improvements of all sorts and as counsellor in all welfare matters. These young men are not experts, but know where to look for them, and can thus act as connecting links between the villages and the various departments—agricultural, medical, co-operative, and so forth.

The Indian Research Fund Association is quoted as an admirable example of combination of private and official effort. The line of research under this foundation which comes to one's mind is that on human and animal nutrition, already referred to in these columns. A great extension of this class of work is hoped for by the Commission—a concerted effort to improve the nutrition contained in the diet of the cultivator is a pressing need.

Education, perhaps fittingly, occupies the next chapter, for "few problems have been more anxiously debated as to the type of education best adapted to an agricultural population. . . ." "The idea that education in rural areas should bear a close relationship to the daily lives of the people is but a recognition of the truth that the environment in which rural workers live is different from that in towns." There is not space to analyse the mass

of facts and ideas which are contained in this chapter, and we shall content ourselves with selecting two of the Commission's conclusions.

The first is in connexion with the influence of female education on rural development. Very few boys attending the primary schools in British India stay long enough to attain permanent literacy. In 1921–22 the proportion of boys attending primary schools was 32·2 per cent of the population, and that of girls 7·6 per cent. On the other hand, the percentages of literacy at 20 years and above were 18·13 and 1·9 respectively: it is evident that girls especially do not stay long at school. It is argued that if a mother is literate, a very strong influence will be brought to bear on keeping her children at school until literacy is assured. The Commission, for the purpose of testing this idea, suggest that "a definite effort should be made to impart literacy to a certain number of young mothers" and the results be carefully recorded.

The second is concerned with the kind of education to be given to older boys in rural India. Two existing types of such education, for boys from fourteen to seventeen years of age, are described and contrasted. In the first the school is vocational, being in fact an agricultural college and farm in miniature, with the important proviso that if the whole four-year course is gone through, all charges will be met by the school; in the second, agriculture is a voluntary subject in a vernacular middle school. The first type, started in 1910 in Bombay, has slowly extended, but it has not been taken up to any extent elsewhere: there are six schools of this type at present. The second type was started in the Punjab in 1923: there were 66 in 1926–27, and it was hoped that there would be 121 in 1927–28. In the United Provinces 20 such schools exist, where, however, agriculture is compulsory. Farms of three acres are intended, but all are not as yet provided with these. The Commission is strongly in favour of this latter class, financially and otherwise. It does not consider that the heavy cost of free vocational schools is justifiable, and there appears to be no general call from the people for them.

The remaining chapters deal with rural industries and labour, horticulture and plantations, and agricultural statistics. There are a number of graphs interspersed and a short series of appendices.

News and Views.

ETHYL petrol—the only motor spirit on the market which contains any lead compound—is, after all, adjudged to be not so deleterious when used under proper safeguards as has been feared in some well-informed quarters. The Departmental Committee which was charged with the examination of the question has issued a unanimous interim report in which it states that, having considered the experimental work which has been done in America, and the evidence which it has itself taken, and having discussed the matter with high officials of the United States Public Health Service, it has reached the conclusion that the findings of the United States Government Committee were justified, and that further experience has supported its conclusion that there are no reasons for prohibiting the use of ethyl petrol. The British Committee does not minimise the risks of using either ethyl or ordinary petrol when ordinary safeguards, such as proper ventilation in garages, are lacking, but it believes that provided ethyl petrol is used solely as a motor fuel, and not for such purposes as cooking or cleaning, its use does not involve a special risk. The dangers attending the manufacture of lead tetraethyl for incorporation into the 'ethyl fluid,' and even the operation of mixing the fluid with petrol, are, of course, in another category. The former operation is not carried out in Great Britain, but in the United States of America it proceeds under proper regulations; the latter stage in the preparation is carried out in Great Britain at nine stations, where the precautions suggested by the United States Committee are observed in all respects, and the arrangements are such that the health of the workers is fully safeguarded.

SCIENTIFIC men who were aware of the peculiarly toxic nature of the material to be employed in the manufacture of ethyl fluid, and of the cumulative effect of the poisonous action of lead compounds in general, and who therefore entertained anxiety concerning the ultimate effect not only on users of the spirit but also on any who might be compelled to breathe an atmosphere polluted with exhaust gases, would have been lacking in an adequate sense of public duty if they had not given expression to their doubts. So far as the evidence is available at present, these fears are not necessarily without foundation, but at least they appear to be concerned with a risk sufficiently circumscribed to fall within that margin of common hazard which modern man has to accept with the other blessings of his civilisation. It remains to be seen whether with the passage of time no such evidence will present itself; in the United States, however, ethyl petrol was in use for some three years before it was introduced commercially into Great Britain, so that the lack of evidence from America in that respect is to be regarded as indicating the improbability of any serious deferred injury. The Committee considers that it would be impossible, and in fact superfluous, to embark on an extensive examination of human subjects in Great Britain, although it proposes to undertake certain confirmatory investigations, and possibly to elucidate some points which have not yet been examined.

EXCEPTION has been taken to the suggestion made at the close of our leading article on "The Museums of the British Isles" (July 14), that the first step in the improvement of the provincial museums should be made by funds independent of the public and the

rates. 'Mr. J. Reeves writes: 'Does the writer seriously suggest that the supply and maintenance of these institutions should be dependent upon private benevolence, and, as a corollary, that existing museums should not receive further aid from public funds, whether taxes or rates? It is not probable that such a view will be accepted by educationists or by many others.' It certainly was not our idea to suggest that public funds presently available for museums should be withdrawn. On the contrary, more money is urgently required. Where is it to come from? In a democratic country public funds are made available only on the insistent demand of the public or its representatives, and the lack of interest of both are painfully evident in the provincial museums which are crumbling to dust, and in the pitiful sums spent upon the majority of local museums, as Sir Henry Miers's tables show. There is little help to be looked for from this quarter.

ON the other hand, some of the best of the American museums depend upon private benevolence or support, and so also do the most flourishing of the zoological gardens in Great Britain. If our museums could be made as attractive as these, there can be little doubt that the interest of the public and of municipal and county authorities would be aroused, and a new demand would be created for the further development of the educational and recreational facilities of museums, at the public expense. The practical difficulty lies in the first step of this process of up-grading the poorer museums. It demands curators with knowledge and outlook, and, in addition to the salaries of such skilled and rare men, money for upkeep and development. In the present financial condition of the country it would be difficult to induce the Government to give the necessary help to provincial museums; many local authorities have shown how limited is their ability or willingness. What remains but private benevolence? We had in mind not so much the desultory help of the private individual, for unfortunately the wealthy men of Britain have not rallied to the support of museums in the way that the wealthy American has, but rather we envisaged the assistance that might be forthcoming from such a benevolent body as the Carnegie United Kingdom Trust, if it felt assured that its preliminary aid would lead to the permanent and progressive improvement of the provincial museum.

THE director of the Royal Botanic Gardens, Kew, has arranged for Mr. J. Hutchinson, assistant at the Herbarium, Royal Botanic Gardens, and formerly assistant for Tropical Africa, to carry out a botanical tour in South Africa in concurrence with the botanical authorities in the Union of South Africa. Mr. Hutchinson left Kew on July 27, and is sailing to Cape Town by the S.S. *Saxon*. Shortly after his arrival at Cape Town he will proceed to Namaqualand with Mr. Pillans, who has kindly invited him to join him on a collecting expedition in that region. Later he intends to make a tour through the Central Coast Region and pay visits to the Knysna forests, Transkei, East Griqualand, and Natal, and the regions which are especially rich in succulents. In the Transvaal and Swaziland Mr. Hutchinson will be assisted as to his tour by Dr. Pole Evans, and he also hopes to visit British Bechuanaland and the Fauresmith Botanical Reserve. The Karroo Flora will be studied, and the autumn Flora of Table Mountain, before he leaves for home in April. Mr. Hutchinson will be visiting the various botanical institutions and gardens in the Union during his stay in South Africa.

THIS tour, which should result in the introduction of many new and interesting plants and valuable specimens for the Herbarium, has been rendered possible through the grant of the Empire Marketing Board to Kew. The portion of the grant assigned for 'Collectors' has enabled Kew to revert to the old practice which was of so much value in the days of Sir Joseph Banks and Sir William Hooker, of sending botanical collectors to study and bring home to the Royal Botanic Gardens plants of economic or botanical interest. The recent mission of Mr. Howes, assistant in the Museums, to Siam, Malay, and Burma in quest of bananas likely to be immune to Panama disease, which was carried out under this grant, has yielded valuable results.

THE Gas Referees have recently extended the use of continuously recording calorimeters for official testings of the gas supplied in Great Britain, and one or more of such instruments has been or is about to be prescribed by them for every gas undertaking which sells more than 2000 million cubic feet of gas per annum. There are already eleven recording calorimeters in use for official testings, and very shortly the number prescribed will be increased to thirty, of which thirteen will be on the gas supplied by Metropolitan and suburban gas companies, and one each at Birmingham, Bournemouth, Brighton, Bristol, Coventry, Croydon, Edinburgh, Glasgow, Leeds, Leicester, Liverpool, Manchester, Newcastle-upon-Tyne, Nottingham, Portsmouth, Sheffield, and Stoke-on-Trent. Three types of continuously recording calorimeter have been approved by the Gas Referees for use in official testings, namely, the 'Boys,' made by Messrs. John J. Griffin and Sons, Ltd.; the 'Fairweather,' made by Scientific and Projections, Ltd., and the 'Thomas,' made by the Cambridge Instrument Company, Ltd. The instrument provided is, in every case, subjected to preliminary trials by the referees before it is certified for use by the officially appointed gas examiner.

IT is reported that a further transference of between 1000 and 1100 bison has been made by the Canadian Department of the Interior, from Wainwright National Park, Alberta, to Wood Buffalo Park, near Fort Smith, in the North-west Territories. The animals were segregated in corrals during the winter, and, as in former years, were moved partly by rail in specially equipped cars, and by river in scows. The number of bisons transferred from Wainwright to Wood Buffalo Park since the movements were inaugurated in 1925, now exceeds 6600. When these transferences commenced, a protest was made in NATURE against the deliberate commingling of the 'plains' and the 'wood' bison, two distinct racial forms, the latter of

which, the only truly wild bison now surviving, ran the risk of being swamped in the crossing that seemed probable. While it is stated that "wardens report that the buffalo placed in the park since the first movement in 1925 are making satisfactory progress," no reference is made to the effect of the presence of an overwhelming number of a strange race upon the characters and survival of the sole existing herd of wood buffalo—a matter of much greater significance. Private advices received from Canada in the earlier days of the transferences suggested that the imported bison had migrated to parts away from the "wood buffalo" herds, but whether a natural segregation has continued we have no recent information.

IN the United States attempts to make scientific knowledge common household stock become more and more pressing, but whether they accomplish their aim is a different matter. The popular anti-fundamentalist journal *Evolution* has already been referred to in our columns; it is a serious endeavour to inform public opinion as to modern views of life, and at the same time to laugh out of court the absurdities of the 'funnymentals.' Science Service of Washington, D.C., issues weekly radio summaries of new things in science, as well as daily jottings "from Nature's notebook." The latter are short accounts of well-known plants and animals, but it is doubtful whether the non-naturalist public will be willing to absorb such descriptions at the rate of one a day. The weekly radio summary of July 5 consisted of almost four foolscap pages describing "babies that walk like bears," a so-called behaviour atavism, the interpretation of which scarcely seems to have reached a degree of scientific security sufficient to warrant public broadcasting. A highly problematical, but very interesting, speculation is contained in a recent communication from Science Service, under the caption, "The Dinosaurs died of Rickets; Dust from Prehistoric Volcanoes shut off Ultra-Violet Rays from the Sun, and the Big Lizards were wiped out by a Baby Disease." The Smithsonian Institution, to the excellent publicity work of which we have often referred, also has a "Scientific News Service." Here one would expect to find a high standard of attainment, and while on the whole the information is sound and freshly expressed, there occur occasional blemishes, such as "According to a Smithsonian palæontologist, three great groups of backboned animals have attained flight—birds, mammals, and reptiles." This is self-advertisement outraging modesty.

ON July 7 a large gathering of chemists from many countries met in Darmstadt at the invitation of the three Societies, the Deutsche Chemische Gesellschaft, the Verein Deutscher Chemiker, and the Deutsche Bunsen-Gesellschaft, to be present at the formal dedication of the national memorial to Liebig and Wöhler at the birthplace of the former. According to the *Chemiker-Zeitung*, the ancient house in which Liebig was born in 1803 had become so dilapidated in 1920 that it had to be demolished, but by the generosity of chemists and the chemical industry in Germany a replica of the original building has been made. The guests were greeted by Prof. Berl in the Otto-Berndt hall of the Technische Hochschule. Prof. J. F. Thorpe presented an address from the Chemical Society of London, and representatives from France, Denmark, Holland, Japan, Sweden, Switzerland, Spain, and Austria were also present. Prof. Haber delivered an oration, in which he eulogised Liebig's character and dwelt upon the influence of his great personality, his wide culture, his peculiar fitness for the tasks which he undertook, his experimental skill, his imaginative vision, and his masterly command of the German language. This was followed by an appreciation by Prof. Wohl of Danzig, of Liebig's great colleague Wöhler, whose work may be said to have paved the way for the development of modern biochemistry. M. Gabriel Bertrand, of the Pasteur Institute in Paris, also addressed the delegates, who journeyed to Giessen on the following day to visit the Liebig museum there.

IN the United States the new Weights and Measures Bill (H.R. 7208), commonly known as the Tilson Bill, furnished a leading topic for discussion at the twenty-first National Conference on Weights and Measures, which was held at the Bureau of Standards, Washington, during the fourth week of May. This Bill, which aims at establishing a certain degree of Federal control over weighing and measuring appliances, was criticised by delegates representing the American Institute of Weights and Measures on the ground that it constitutes an insidious attempt to drive in the 'prometric' wedge, the thin end of which was inserted by the issue of the Mendenhall Order in 1893. The critics of the Bill regard that Order, promulgated by Prof. Mendenhall when Superintendent of Weights and Measures, as *ultra vires* because, having none but departmental authority, and notwithstanding a provision of the constitution which vests solely in Congress the power "to fix the Standard of Weights and Measures," it declared the fundamental standards of the country to be the metre and the kilogram, in place of the yard and the pound respectively, and defined the latter units in terms of the former. They also appear to look upon the Bureau, in spite of its present director's disclaimer, as having pro-metric sympathies and aims, and they therefore wish for the Bill to be amended in such a way as to circumscribe strictly the powers of the Bureau as well as to restore the pre-eminence of the yard and pound as fundamental national standards and to preserve their absolute identity with those of the British Empire. The amounts by which the ratio of the yard to the metre is found to vary on successive comparisons are, from a practical viewpoint, infinitesimal, but the mere fact that the metric *units* are administratively defined as fundamental is feared to furnish a dangerously specious argument for the extended use of the metric *system*, and ultimately for its legislative enforcement.

THE expedition sent by the New York Zoological Society to the Galapagos Islands in the spring of the year has returned safely with its mission fulfilled. Its object, under the leadership of Dr. C. H. Townsend, was to save alive a remnant of the giant tortoises of

the islands, and preliminary reports published in the *New York Times* and *Science* show how desirable that action had become. In the days of Dampier (1864) the tortoises were innumerable; in later times seventy-nine new Bedford whalers carried off 13,000 tortoises, an invaluable article of food. Now the tortoises are extinct on all but two or three of the islands in the group, and Dr. Townsend confirms the reports of recent visitors that the giant tortoise cannot long survive even there, since all the eggs and young are destroyed by wild dogs, pigs, cats, and rats. Once common throughout the islands, the tortoises are now confined to mountainous regions difficult of access to man. The only hope of keeping the stock alive was to establish it in conditions where its safety and continuance could be assured so far as human devices go. Accordingly, the expedition captured 180 live tortoises and, having transported all in safety, it has placed breeding colonies of 15 to 30 individuals at half-a-dozen stations in tropical and sub-tropical Central and North America, in the belief that at some, if not at all of the stations, breeding and successful rearing of young will take place. Since all the captured specimens have been numbered and weighed, the experiment should yield information as to rate of growth and age. A dozen skeletons of the long-extinct tortoise of Charles Island were also obtained by the expedition.

AFTER the conferring of degrees in medicine in the University of Edinburgh on July 18, Prof. W. Wright Smith addressed the graduates on the subject of the place which the physician has held in the world and the position he is likely to occupy in the future. The physician's is no longer merely the healing art; trend of medicine is to the prophylactic. Reference was made to the opinions of doctors held by various writers, medical and lay, and among the latter, Robert Louis Stevenson. Prof. Smith said, though it was possibly not on record that Stevenson ever meditated becoming a doctor, he had it on the authority of his predecessor, the late Sir Isaac Bayley Balfour, that Stevenson began attendance on the class of zoology then held in the summer term. In the practical class the men worked in pairs, and Stevenson and Balfour worked together, and the crayfish was their first venture. The work was divided on the principle that Balfour did the dissection while Stevenson read the details from the text-book. But on the morning of the third day, under their attentions and those of the summer sun, the crayfish lodged a strong protest. With a vivid comment thereon Stevenson departed, and did not again appear in the precincts of the Zoology Department.

DR. FARNELL's recent lecture to the British Academy on "Hedonism and Art" (London: Oxford University Press, 1*s*. net) deserves some notice by men of science, because, although he does not specifically mention it, the question at issue touches both science and art. As we know, they are closely connected activities of the mind, and in the case of art it has frequently been claimed that the giving of pleasure is its primary object. It is this contention that Dr. Farnell disputes and disposes of. In place of the "flowery tracks of pleasure" he would substitute "sublimity, high-souledness, nobility in sentiment and thought." The conscious reaction to a work of art "in the susceptible hearer or spectator" is certainly not to be called pleasure, but rather "uplift, awe, admiration, consciousness of the higher value of a nobler world than that of our normal self, a world from which the true hedonist is excluded." He illustrates this to good effect from many great works of art, especially from the poets, and his conclusion seems to be sound. For a full discussion, however, much more than a pamphlet of 19 pages is needed, and any such discussion should include the companion sphere of science in which similar, though not precisely identical, considerations would be found to hold good. In each sphere the true goal and the higher sense of achievement is reached just in so far as the work of science or of art enlarges and elevates the spiritual world in which we live. This merging and elevation of the individual in a greater sphere is the true explanation of both, the difference being, as Francis Bacon once put it, that in science, man grows by taking Nature into himself—in art he projects or adds himself to Nature. But Dr. Farnell's lecture deserves a careful reading and contains nothing contradictory to the wider view in which science and art may be seen as complementary and connected aspects of spiritual growth.

THE Littlehampton Nature and Archæology Circle is a thriving local society of 56 members, which has completed its fourth year of existence, and the reports for 1926 and 1927 that we have received show that much important work has been done. Exploration of the low cliff of brick-earth at Kingston has shown, by an examination of the non-marine mollusca by A. S. Kennard, that the lowest bed is a late pleistocene deposit, and it apparently deserves further exploration. An interesting piece of exploration has been done in Arundel Park, at Nanny's Croft, where a Roman road appears to have led down to the River Arun from settlements on the Downs, which thus were linked up with the trade passing up and down the river. The road terminates in a causeway below the river bank. Evidence of iron-melting was found, and some pounds of slag obtained. About 600 feet of trenching was carried out, and many fragments of Roman pottery, tiles, bricks, and four coins of Constantine I., Valentian I., etc., were found, the date of the occupation of the site being thus approximately the fourth and fifth centuries. The remains of bones found also indicate, according to Sir Arthur Keith, Roman age. There were no Saxon or Norman remains. The report also contains bird-notes, from which we note a sight of a peregrine falcon on the Arun, a supplementary list of local flowers, and a short description of the Old Manor-House at Rustington, the frontispiece to the volume being an illustration of the timber-work of the formerly concealed west front.

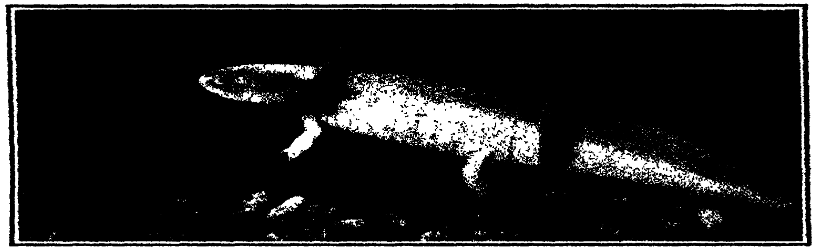
THE greater part of the inaugural address on "The Impact of Science upon an old Civilisation," given by Prof. F. Soddy at University College, Aberystwyth, in October last, has recently been

published by Messrs. Hendersons, 66 Charing Cross Road, London, as a pamphlet (price 6*d*.). The pamphlet epitomises Prof. Soddy's views on the monetary system of the civilised world which he dealt with exhaustively in a recent volume. In his opinion, that system was attuned to the principle of scarcity upon which he alleges our civilisation is still based, in spite of the fact that the impact of science upon productive processes has made possible the easy satisfaction of the necessities and essentials of a healthy and abundant existence for a far greater population than the world supports to-day. The fact that 'sufficiency' has not been realised he attributes to the persistence of an antiquated non-scientific orthodoxy in the spheres of economics and finance. "Our [present] civilisation demands and, through its financial system, issues an edict," he says, "that there shall be no production unless there is a willing and solvent debtor to owe for the product."

SOCIETY, Prof. Soddy states, befogged by the reiteration of the static beliefs of those steeped in the classical tradition, is still apparently unaware of the cause of present discontents, although made uncomfortable by its symptoms, or that it is drifting rapidly towards the abyss. It fails to realise that the proper function of a monetary system is to facilitate and expedite the interchange of goods and services and not the enrichment of private usurers. Nevertheless, there is a quickened interest in the matters dealt with in Prof. Soddy's pamphlet. There are even rumours of the possibility of a Royal Commission on Finance. If there were more scientific workers like him, prepared to approach the problems facing society in the same spirit as they approach their specialised studies, the civilised world might possibly be stirred from its complacent indifference to the urgent need for a critical investigation of the present system.

ON the occasion of the annual meeting of the British Medical Association at Cardiff on July 20–28, the Wellcome Historical Medical Museum has published an announcement, accompanied by numerous illustrations, of the "History and Lore of Cymric Medicine," which is to form the next addition to the Research Studies in Medical History issued by the Museum. The forthcoming work claims to be a trustworthy source of information for students, research workers, and all those interested in the evolution of medicine from the most primitive times. The book will contain a full description of ancient medical lore in Wales from the palæolithic period onwards, and will include translations of the celebrated medieval Welsh manuscript known as Meddygon Myddfai. The results of the study of the chronicles of epidemics from the earliest times are to be recorded, as well as the history of healing wells, charms, amulets, and talismans connected with Cymric medical lore. A section is devoted to the Cardiff medical school, with a biographical review of notable Welsh doctors. Members of the medical profession and others possessing books, manuscripts, and other useful information on the subject of the history, folklore, and legends dealt with in this work are requested to communicate at once with the Conservator of the Wellcome Historical Medical Museum, 54 Wigmore Street, W.1.

THE British Aquarists' Association Exhibition was held at Trinity Hall, Great Portland Street, London, W.C.1, on July 24–28. There were about 600 exhibits, including some very rare specimens, such as white orandas, which are the highest point in the hybridisation of the fancy goldfish, the harlequin-hued shubunkin, and telescopic-eyed veiltail, and grotesque black telescopic-eyed veiltail. There were also specimens of *Copeina Arnoldi*, the male and female of which leap out of the water when spawning, and the eggs are laid on the side of the aquarium about two or three inches above the surface; after completing spawning, the male drives the female away, and splashes the eggs with water with his tail. Another interesting fish was the climbing African perch, which is able to propel itself on land by means of its pectoral fins in search of water in the event of drought. Other exhibits included the angel fish, the aristocrat of all



Photo] FIG. 1.—Albino axolotl. [*E. C. Le Grice.*

aquarium fishes, fine lizards, and Japanese tree frogs, which arrived from Yokohama, via Siberia, by letter post in a tobacco tin, and dwarf chameleons. The 'best fish' in the exhibition was judged to be white oranda, owned by Dr. H. B. Jones; and the 'best reptile,' a pair of axolotls shown by Mr. H. Whitley. A noteworthy feature of the show was the stall by Mr. Amos Perry, Enfield, on which were shown many beautiful *Nymphæ*, and other rare plants. The pond life exhibits, with their minute aquatic insects and other creatures, also created much interest. One fish, a blue telescopic-eyed veiltail, was sold for £100. The whole arrangement of the show was to demonstrate that fish can be kept in aquaria, and will live there if only reasonable precautions are taken. Mr. A. W. Croser, the Hon. Secretary of the British Aquarists' Association, 12 Winkfield Road, Wood Green, London, N.22, will be glad to give information on home aquaria, etc.

MR. A. PAGE, the chief engineer to the Central Electricity Board, in the course of an interesting paper on the electric transmission of power, read at the recent centenary conference of the Civil Engineers, pointed out that the ideal to be aimed at is to make electricity available without restriction throughout Great Britain. The system chosen, therefore, must

be extremely flexible, so as to make the supply trustworthy and reduce the charges to the consumer. Since the price of the coal used for the boilers varies very little in different localities, there is a wide choice of suitable sites for power stations. As many of these sites have already been developed, the problem resolves itself into selecting the best of them for association with the 'grid.' The voltage and carrying capacity of the grid lines have been fixed at 132 kilovolts and 50,000 kilowatts respectively. It is interesting to know that in New York and Chicago there is now a considerable length of line operating at 132 kilovolts. The conductors are of aluminium with a steel core, and their size is such that there is little risk of brush discharge taking place even under the most unfavourable weather conditions. After a careful study of the effect of foggy salt-laden atmosphere on high tension insulators, it was decided to use suspending strings containing nine of them in series. Induced voltages in the line due to lightning flashes in the neighbourhood are very unlikely to flash over these strings of insulators. There is, however, no certain way of escaping the consequences of a flash striking the line directly. Methods have been developed for disconnecting faulty lines for repair without interrupting the supply. One point Mr. Page emphasised was that the main function of the grid lines was to act as interconnectors, and not merely for power transmission. Hence they had only to carry a fraction of the energy generated in Great Britain. The percentage energy losses in these mains, therefore, would be practically negligible and would diminish as the load developed.

WE are informed by Imperial Chemical Industries, Ltd., that Dr. E. F. Armstrong, having resigned his position as a director of British Dyestuffs Corporation, Limited, has accepted a retainer as consultant to Imperial Chemical Industries, Ltd.

MR. J. G. PEARCE, director of the British Cast Iron Research Association, has been unanimously awarded by the judges the first prize of 100 guineas for a series of practicable proposals relating to 'Goodwill in Industry.' The competition was organised by the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, and the judges represented the three parties in industry—the employer, the worker, and the technical or administrative officer.

THE Department of Zoology of the British Museum (Natural History) has received an important collection of mammals and birds obtained by a Franco-British expedition to French Indo-China under the leadership of M. Jean Delacour, with whom was associated M. Pierre Jabouille. The collection comprises 151 mammals and 1794 birds: of these, three mammals and twelve birds are forms new to science and are therefore of considerable systematic interest.

IT is announced in *Science* that Thomas A. Edison, John J. Carty, Michael I. Pupin, Ambrose Swasey, and Elihu Thomson have been elected honorary members of the American Institute of Electrical Engineers. This is the first time that any American honorary members have been elected.

THE *Medical Press and Circular* (8 Henrietta Street, London, W.C.2) is now issuing quarterly a "Literary Number," a feature of which is a bibliography of medical books published during the previous three months. The bibliography is comprehensive and is designed to cover the literature of the medical and allied sciences of the whole world. The second literary number was published on July 11.

THE McGraw-Hill Publishing Co., Ltd., has issued a useful list (No. 13) of books on mathematics and physics, the mathematics section including advanced and practical or engineering mathematics. Each title is accompanied by a brief note on the style and scope of the book and a list of the chapter headings, so that it is possible to judge quickly as to the suitability or otherwise of any book for a particular purpose.

THE appearance of a third edition of the illustrated handbook on the house-fly, by Major E. E. Austen (British Museum (Natural History), Economic Series 1A, 1928; 1*s*.), affords ample testimony to its utility. Although only two years have elapsed since the publication of the last edition, new discoveries of importance have been made, and with these facts in mind its text has been thoroughly revised. We commend this excellent publication to all interested in public health and fly suppression. It is obtainable through booksellers.

THE U.S. Coast and Geodetic Survey has issued, as *Special Publication No. 139* (price 20 cents), a useful booklet of 78 pages entitled "Instructions for Tide Observations," by G. T. Rude. It summarises for field purposes the methods used by the Survey in obtaining tide observations, and in making the reductions of the tide records necessary for the establishment of planes of reference for reducing the soundings of a hydrographic survey. Being intended as a working manual, the methods of computation described are restricted to those required for field use, and no theoretical discussions are included.

THE Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W.15, has organised an "Anti-Malarial Advisory Committee," with the object of assisting tropical industries in carrying out practical measures to combat the disease. The technical members of the committee are Sir Malcolm Watson, Sir Ronald Ross, Sir William Simpson, and Sir Aldo Castellani, and the lay members include representatives of a number of rubber, cotton, gold, and other mining companies and associations. The anti-malaria staff at the Institute will be at the disposal of these companies for advice, and it is intended that Sir Malcolm Watson himself shall visit some part of the tropics every year for a short period.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A part-time evening lecturer and instructor for carpentry

and joinery at the Acton Technical Institute—The Principal, Chiswick Polytechnic, Bath Road, Bedford Park, W.4 (Aug. 8). An assistant master to teach mechanical engineering subjects to junior technical pupils and evening adult students at the Redhill Junior Technical School—The Clerk to the Governors, Education Office, Municipal Buildings, Reigate (Aug. 8). A junior technical officer in an Admiralty Experimental Establishment the work of which consists mainly of design in connexion with acoustical and electrical apparatus — The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Aug. 11). A wood workshop instructor for the Junior Technical School of the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Aug. 15). A research chemist under the Safety in Mines Research Board, for the study of ionisation during gaseous explosions — The Under Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Aug. 18). A woman demonstrator and assistant lecturer in the department of chemistry of the Royal Holloway College — The Principal, Royal Holloway College, Englefield Green, Surrey (Aug. 30). A physics graduate at the Northampton Polytechnic Institute, partly for teaching and partly for research in ophthalmic optics—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1 (Aug. 30). An assistant lecturer and demonstrator in the British School of Malting and Brewing and department of the Biochemistry of Fermentation of the University of Birmingham—The Secretary, University, Birmingham (Aug. 31). Two chemists for the Meat Products Research Branch of the N.Z. Department of Scientific and Industrial Research, Wellington—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Sept. 8). A chief assistant entomologist at the Rothamsted Experimental Station — The Secretary, Rothamsted Experimental Station, Harpenden, Herts (Sept. 15). A lecturer in biology at the Portsmouth Municipal College—The Secretary, Municipal College, Portsmouth. A head of the mechanical engineering department of the Darlington Technical College—The Chief Education Officer, Education Office, Darlington. A head of the Junior Technical School of the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A principal of the North-Western Polytechnic (now being erected) —The Clerk to the Governors, North-Western Polytechnic, 3 Temple Gardens, Temple, E.C.4. A laboratory assistant in the Department of Agriculture and Forests, Khartoum—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1.

Our Astronomical Column.

Magnetic Storms and Sunspots.—Under the title "Large Magnetic Storms and Large Sunspots," in *Monthly Notices Royal Astron. Soc.*, May 1928, W. M. H. Greaves and H. W. Newton discuss the occurrence of sunspots at the time of magnetic storms for the 54 years 1874–1927. Magnetic disturbances are included for which the range in declination was at least 1°, or that in H.F. or V.F. at least 300 γ. Sunspots of mean area 500 millionths of the sun's hemisphere or greater are considered significant in a comparison with magnetic storms. The analysis shows that out of 60 magnetic storms, 36 commenced within 4 days of the central meridian passage of a large spot (chance would give about 17 coincidences between spot and storm); 8 other storms commenced within 4 days of the central meridian passage of a region of the sun which had previously been markedly disturbed; in 7 other cases the storm was followed one solar rotation later (about 27 days) by the transit of a large spot which had developed in the interval; the remaining 9 storms occurred when neither spots nor faculæ were unusual. When the largest magnetic storms were examined ($D \geq 1\frac{1}{2}°$ or H.F. or V.F. $> 500\,\gamma$), it was found that 15 out of 17 storms occurred in conjunction with a large spot; the sixteenth storm took place one solar rotation after the central meridian passage of a large spot, while the seventeenth storm preceded by one solar rotation the central meridian passage of another large spot (see Nature, May 26, p. 842). These figures show that individual storms and individual spots are associated with each other more often than can be ascribed to chance, and that the tendency to association is greater for the largest storms.

Little evidence is found of a tendency for these magnetic storms to recur one solar rotation later. This is not necessarily in contradiction to Maunder, who found a definite tendency for magnetic disturbances to recur about 27 days later (*Monthly Notices R.A.S.*, pp. 19-22, etc.; 1904). The present authors have collected data for the period 1874–1927 relating to smaller storms (such as were included by Maunder in his analysis), and a discussion of this class of magnetic disturbance may show a more definite recurrence phenomenon.

Saturn's Satellite Hyperion.—This satellite has attracted the special attention of dynamical astronomers owing to its large perturbations by Titan, and the fact that the mean motions of the two are nearly commensurable, in the ratio of 4 to 3. The *Annals of Leiden Observatory*, vol. 16, Part 3, contain a new investigation by J. Woltjer, Jun. He gives a revised theory, and a comparison with observations from 1875 to 1922; also tables for computing the motion as perturbed by Titan.

The discussion affords three different determinations of the mass of Titan, from the motions of (1) the argument of libration, (2) the longitude of peri-centre, (3) the node. The values of the reciprocal of the mass, compared with that of Saturn, are 3986, 4080, and 3767 respectively; combining these with values found by Brouwer, Eichelberger, and Samter, he adopts the weighted mean 4033. This makes the mass of Titan 1·9 times that of our moon, but its density is only about half that of the moon.

The comparison with observations brings out the superiority of the method of comparing one satellite with another, rather than with Saturn itself. The latter method was used up to 1887 and gave for the mean error of one observation values that ranged from $\frac{1}{4}''$ to $\frac{3}{4}''$; the other method was then introduced by Struve at Pulkovo and reduced the mean error of an observation to $\frac{1}{8}''$.

Research Items.

PREHISTORIC CULTURE OF THE COLUMBIA RIVER, U.S.A.—In vol 73, art. 11, of the *Proceedings of the U.S. National Museum*, Mr. H. W. Krieger describes the results of an investigation of a prehistoric pit-dwelling village at Wahluke, Grant County, Washington, which was undertaken as part of a general survey of the Columbia River area with the view of determining the character of the culture of its early inhabitants and its relation to neighbouring cultures. The area is of considerable importance ethnologically, as the Saddle Mountains form a barrier dividing Salish from Shahaptian-speaking Indians. Geologically, the formation makes it possible to determine without question that man could not have inhabited the area in pleistocene times, and that the relics of early man attributed to pleistocene deposits or associated with pleistocene faunal remains are intrusive. The culture of the pit-house village is especially interesting, as indicating the exhaustive manner in which the inhabitants exploited the natural resources of the area, more particularly in the development of their stone culture, no less than twenty-five varieties of stone being enumerated, of which they made use in the manufacture of tools and implements. It is to be noted that all forms of the stone axe were lacking in the surface finds and among the grave offerings; the inhabitants of Wahluke depended on the hafted discoidal stone war club, the flaked hammerstone, the grooved maul, and the stone wedge in its stead. The cemetery contained both primary and secondary burials, but practically no other type than that of ceremonial burial. A few skulls were recovered from among the remains. These showed artificial deformation, and the occipital flattening due to the use of an uncovered cradle board. The frontal occipital flattening was produced by a cradle board flap similar to that used by Columbian Indians in historic times.

A THEORY OF THE SMILE.—In *Psyche* (vol. 8, No. 4) Mr. A. M. Hocart develops a theory of the smile. He points out that the origin of the smile does not seem to have been satisfactorily explained by psychologists. Even Prof. Wm. McDougall, who explained the laugh as a protective reaction (NATURE, vol. 67, 1903) left the smile on one side. A search among other animals may furnish some clue. When a dog is pleased, especially when it is full of fun, it opens its mouth slightly, draws back the corners of the mouth, and bares its teeth. If one tickles it under the arm pits as it is lying, it is apt to draw back the corners of its mouth slightly without baring its teeth. A puppy welcomes its master with its ears cocked, a distinct gleam in its eyes, wagging its tail and smiling. As its master draws nearer, it rushes toward him and proceeds to chew his hand. The smile then may be the resultant of two opposite tendencies, the impulse to tear with the teeth and the impulse to suck and lick the object of affection. Adult man does not habitually bite the object of his affection, but there is a tendency that way which usually betrays itself only in words; in children there is a distinct tendency to chew affectionately. This tendency is in man early repressed and only breaks out into action under the stress of violent emotion. The parallel between the man's smile and the dog's is so close, that they may be identified, the differences being due to man's more complex development. The author offers these suggestions in the hope that they may stimulate research into the question. Darwin in his "Expression of the Emotions" related the smile to the expression of pleasure in sucking.

DEATH AND EVOLUTION.—In former papers Prof. Raymond Pearl has suggested, from statistical analyses, that the different organ systems of the human body are not all equally capable of withstanding disease, and that the distribution of human mortality is associated with the evolutionary history of the human body. A further study suggests that the incidence of disease in various organ systems has an evolutionary significance throughout the vertebrate series (*Quart. Rev. Biology*, vol. 3, June 1928, p. 271). His animal statistics are drawn from the records of deaths at the Gardens of the Zoological Society of London for the four years 1920–23, 4448 deaths in all. The predominant causes of death amongst vertebrates, including man, are associated with the alimentary, the respiratory, and the circulatory systems in the order named, and of these the first two are by far the most mortal. But whereas there is a decreasing ratio of alimentary fatality from reptiles to birds and from birds to mammals, the order is reversed in the case of the respiratory system. It would seem, therefore, that while the evolution of the respiratory system has made it more and more vulnerable to the attacks of disease, the alimentary system has gradually attained a greater disease-resistance. Again, if the incidence of deaths be tabulated according to the primary germ layers from which the organs arose, it is seen that in all vertebrate groups, including man, the endoderm series is most vulnerable, the ectoderm series least vulnerable. Further, whereas the ratio of deaths associated with ectodermal organs increases from the lowest to the highest vertebrate, the order is exactly reversed in the case of endodermal organs. Although the nervous system does not stand high in the incidence of death, it is interesting to note that in civilised man its vulnerability is enormously greater than in any other vertebrate group, the ratios, from 100 deaths in each group, being, reptiles 0, birds 0·12, mammals 0·64, man 8·91.

FOREIGN BIRDS ESTABLISHED IN NORTH AMERICA.—A summary of all the facts that can be learned about the introduction or transplantation of birds in North America has been compiled by John C. Phillips (*U.S. Dept. Agr. Tech. Bull. No. 61*, April 1928). The list contains the names of a wonderful variety of birds, from tinamous to sparrows, but relatively few of the many have succeeded in forming permanent colonies. Some were mere escapes from captivity, which had little chance of survival, but even amongst the birds deliberately planted in the new land, for their beauty, their value as songsters, or their sporting qualities, there were many failures. Some, such as the capercaillie, black game, and many European songbirds, vanished almost as soon as they were liberated; others nested for a season and then declined, although all the conditions seemed favourable for survival; still others, for example, the European skylark and goldfinch, survived and bred for a term of years and then disappeared; only a small minority of forms found conditions so favourable that they settled down and multiplied. The English house-sparrow, the starling, the pheasant in Massachusetts, and the partridge in the north-west have been extraordinarily successful colonisers; but as a rule the first outburst of success is soon checked by natural causes, and a fresh balance is established. It has even happened that an alien, at one period so prolific as to be regarded as a pest, has entirely disappeared when Nature has had time to bring her opposition forces into line.

BIOLOGY OF THE OYSTER AND OTHER LAMELLIBRANCHS.—In the April number of the *M.B.A. Journal* (N.S., 15, 2), J. H. Orton finds that shell-growth, fattening and breeding of *Ostrea* are mainly governed by temperature. He is thus able to describe three types of environment by reference to which most oyster beds may be defined. Many other aspects of the oyster's internal and external economy are discussed. C. Amirthalingham investigates the state of sexual maturity of *Pecten*, which undergoes changes having a well-defined lunar periodicity. C. M. Yonge combats the view that *Ostrea* can absorb soluble substances directly through the superficial epithelium. He shows that the appearance of this phenomenon in the experiments of other workers is almost certainly to be attributed to the action of leucocytes liberated on the epithelia in 'bleeding,' which is liable to occur in unfavourable conditions. A. C. Stephen gives a general account of the biology of *Tellina tenuis* in Cumbrae bays.

PARASITISM AS A SEX-DETERMINING FACTOR.—In the *Official Record U.S. Department of Agriculture* (vol. 6, No. 43; 1927) is an interesting account by N. A. Cobb, G. Steiner, and J. R. Christie of observations on the nematode *Mermis subnigrescens*, a common parasite of grasshoppers. These became parasitised by swallowing the eggs of *Mermis* which had been deposited on the food-plant of the grasshoppers. The infective egg contains a well-developed worm. In thousands of observations the average number of worms per infested grasshopper in Nature was from one to three, and always females. Females, in the absence of males, can produce viable eggs which give rise to infective larvæ. Experiments were made to determine the dose of eggs of *Mermis* that would be fatal to the host, and for young grasshoppers in the second instar this was found to be well under fifty eggs. When a slightly sublethal dose of eggs was given all the resulting worms were males; *e.g.* 20 *Mermis* eggs were fed to a grasshopper previously free from this parasite, and the resulting 19 worms were all males, whereas feeding with a very few eggs resulted in female worms. Corresponding observations on a *Pseudomermis* in the larvæ of a midge (*Chironomus*), on an *Agamermis* in the tea bug (*Helopeltis*), and on an *Allomermis* in the common ant (*Lasius niger*), showed that when the parasitism was high the worms were males, and when low were females. Between those extremes were gradations, the proportion of males varying with the severity of the parasitism. The authors consider that here is a case where environment is a sex-determining factor which becomes potent not during the early embryology of the worm but after a well-developed, highly differentiated larva has been formed.

TRICHOMONAS HOMINIS.—Robert Hegner (*Jour. Amer. Med. Assoc.*, 90; 1928) records experiments on *Trichomonas hominis* from the intestine of man, on *T. buccalis* from the mouth of man, and on six other species from monkey, cat, rat, chicken, and frog. Twenty-one tubes of serum-saline-citrate medium were inoculated with each of the eight species of *Trichomonas* and immediately fresh blood was added, three drops to each of three tubes, from man, dog, cat, rabbit, rat, guinea-pig, and mouse, and the material was incubated for twenty-four hours except in the case of the trichomonads from the frog, which were examined at the end of five hours. Every species of trichomonad ingested red cells from each of the seven species of mammals; the number ingested by any one trichomonad varied from one to seven. *T. hominis* from the mouth of man ingested the largest number of red cells; of those offered rat's blood, 96 per cent had ingested one or more red cells. The data suggest that the larger the size of the red cell the more difficult is it for the trichomonads to ingest it. The author concludes that the species of *Trichomonas* accept red cells as food just as they do other food particles (*e.g.* bacteria and organic debris) and is not to be regarded as evidence of pathogenicity. In another paper (*Amer. Jour. Hyg.*, 8, No. 1; 1928) Prof. Hegner examines the viability and transmission of *T. hominis*, which has no cyst stage in its life cycle and hence must pass from host to host in its trophozoite phase. The results indicate it is highly improbable that the cockroach ever serves as a transmitting agent, but that flies fed on infected material, from twenty minutes to four hours afterwards, deposit fæces or vomit drops containing living *Trichomonas*.

LIMITING VITAL FACTORS IN FRESH AND SEA WATER.—In an article entitled "Die biologische Bedeutung der Salzkonzentration der Gewässer (*Die Naturwissenschaften*, Heft 14, 229; 1928), C. Schlieper gives an interesting account of some of the physical causes of the poverty of the fresh-water fauna compared with that of the sea. The importance of osmotic pressure is considered first, especially the well-known dependence of the osmotic pressure of the body fluids of marine invertebrates on the external osmotic pressure. But as Beudant showed so long ago as 1816, many typically marine organisms can withstand gradual change to completely fresh-water conditions, and, therefore, osmotic pressure alone does not seem to be the most serious factor in preventing migration from the sea to the fresh water. By comparing the morphological differences between fresh-water and marine organisms, the author makes the suggestion that organs of respiration are more highly developed under fresh-water conditions. He concludes that respiration itself is more difficult in this case, and that this is the true limiting factor which determines existence in fresh water and the sea. This factor might be due to difficulty of oxygen absorption or of carbon dioxide excretion. The quantities of oxygen dissolved in equivalent volumes of salt and fresh waters are not seriously different, and oxygen cannot, therefore, be a limiting factor. It is considered that the chief factor is the ease with which carbon dioxide can be excreted and that this is related to the greater bicarbonate content of sea as opposed to fresh water. This is an interesting suggestion, but physically the fresh water and marine environments differ so fundamentally that it seems impossible to ascribe their faunistic differences solely to a single factor such as this. The immense variability of temperature, pH, etc., and the geological inconstancy of fresh water as opposed to the sea, must also be factors of prime importance.

CULTIVATION OF PERENNIAL COTTON IN EGYPT.—In the most important cotton-growing countries, the plant has for years been cultivated almost exclusively as an annual. It must not be forgotten, however, that it is a true perennial in habit, and in almost all countries where it was cultivated it was originally treated as such. The voluminous literature on the subject deals almost entirely with the behaviour of the plant in its first year, but quite recently a controversy sprang up in connexion with perennial cultivation. The majority of the authorities is against the practice for a variety of reasons, chief of which are that the quality of the fibre is held to deteriorate after the first year, and that plants left in the ground more than one year will carry insect pests over the winter, and so result in increased attack. In a recent paper, Dr. J. Templeton has brought together a mass of evidence relating to perennial cultivation of cotton in

various parts of the world, and also describes experimental work carried out in Egypt (*Bulletin*, No. 75, Technical and Scientific Service, Ministry of Agriculture of Egypt). The evidence of the experiments as regards staple quality of first pickings is on the whole definitely against the theory that deterioration takes place after the first year. In addition, the 'ratoon' is of a higher class than the first year cotton. Second-year plants cannot carry the insect pests of cotton in Egypt over the winter, and suffer less damage from insect pests in general than first-year plants. The flowering curve of the second-year plants rises more rapidly and reaches a maximum much earlier than that of the first year, thus shortening the useful flowering period, which has an important bearing on the possible damage to the crop from pink boll-worms. The cost of cultivation is also less, no seed being required in the second year and no sewing, resowing, or thinning. Lastly, given pure seed to start with, the crop will remain pure longer.

MINERALS OF SOUTH AUSTRALIA.—The *Half-Yearly Mining Review*, issued by the Department of Mines of South Australia for the half-year ending Dec. 31, 1927, states among the general notes that a new geological map of the State has been printed and is now available. Owing to the fact that it is many years since a previous edition was published, the present map contains much new information, the plotting of the pre-Cambrian rocks being especially important, because the great majority of the mineral deposits of the State occur in this formation. There is also a short notice of the new method of geophysical prospecting, which is to be tried out in Australia under an arrangement between the Empire Marketing Board and the Commonwealth Council for Scientific and Industrial Research. The general indications given by a geophysical survey and their limitations are clearly explained. It is shown that this method gives indications which can be usefully followed up by drilling or other methods of definite exploration, and the point is stressed that a geophysical survey cannot by itself record the presence of any particular kind of ore, and above all cannot indicate the existence of rich ore until the presence of such ore has been actually proved by drilling. The most interesting feature in the statistical returns is the steady increase in the production of iron ore, which has now reached nearly three-quarters of a million tons, and the value of which is rather more than half of that of the total mineral production of the State.

CATHODE PHENOMENA.—Prof. Güntherschulze points out in the issue of the *Zeitschrift für Physik* for July 4 that the usual assumption that the least potential at which a Geissler discharge can be maintained on a cold cathode is independent of the pressure of the gas, is based upon very scanty evidence, and some new measurements made by him with a massive iron cathode shew that it is by no means always true. Helium, neon, argon, oxygen, and air do certainly exhibit a remarkable constancy of the minimum cathode fall in potential, although there is a small systematic rise for the first three gases with decrease in pressure, but with nitrogen and hydrogen, changes of the order of a hundred volts occur between pressures of one-tenth of a millimetre of mercury and five millimetres of mercury, and it is obviously difficult to attempt to correlate the discharge constants with the thermionic and photoelectric properties of the cathode in such cases. Prof. Güntherschulze's measurements were not made by the accurate but laborious method of exploring electrodes, but there can be little doubt that his results are substantially correct.

SOUND-PROOF ROOMS.—In developing transmitters and apparatus for sound reproduction it is necessary to work in a room which is practically sound-proof. Formerly the walls of rooms were deadened with hair, felt, and other absorbing materials, but the result was not good. Recent theories of sound absorption have shown where the old methods were unsatisfactory. In addition, celotex, a new building material made of matted vegetable fibre and commonly used for heat insulation, has been found to be an excellent absorber of sound. The sound-proof rooms of the Bell Telephone Laboratories of New York are described in their *Record* for June. The rooms are first made with brick walls four inches thick, covered on both sides with hard cement plaster. This structure has a minimum tendency to resonate and a maximum tendency to reflect sound. The doors are built of two thicknesses of $\frac{1}{4}$-in. steel plate, separated by an air space, and are fastened by clamps similar to those used on water-tight bulk-head doors. Inside the masonry wall, and separated from it by an air space, is an inner room built of wood and covered with celotex, separated from the wood by a sheet of metal $\frac{1}{16}$ in. thick, inside which are four successive layers of celotex. The room is supported on as few wooden blocks as possible. In practice it is found that the smallest opening permits the passage of sound. Outer and inner doors, therefore, are arranged so that they are clamped against cushions of rubber foam. To provide the necessary ventilation a labyrinthine duct runs to each of the rooms. Thirteen rooms have been constructed in this way. So far as sounds of fairly high frequency are concerned, they are sound absorbent, but sounds of low frequency are transmitted through the entire structure. The more nearly sound-proof the room is the more sensitive do listeners become to slight sounds. In the present state of our knowledge, an absolutely sound-proof room seems to be impracticable.

CRYSTAL STRUCTURE OF IODINE.—Comparatively few of the non-metallic elements have had their crystal structures elucidated by X-ray analysis, although in the case of non-polar substances such information is especially interesting in connexion with the existence of molecules in the crystals. An investigation of the atomic arrangement in the iodine crystal by the Laue, oscillating crystal and powder methods has been carried out by P. M. Harris, E. Mack, and F. C. Blake, and is described in the *Journal of the American Chemical Society* for June. The unit cell of the ordinary form of iodine has orthorhombic bipyramidal symmetry and was found to contain eight atoms. Its dimensions are $a_0 = 4{\cdot}795$ A., $b_0 = 7{\cdot}255$ A., $c_0 = 9{\cdot}780$ A. The atoms are grouped in molecules of I_2, the distance between the centres of the two atoms in one molecule being 2·70 A.

BORIC ACID ANHYDRIDE AS A DRYING AGENT.—The use of boric acid anhydride for the removal of water has occasionally been advocated, and in the *Journal of the American Chemical Society* for June, J. H. Walton and C. K. Rosenbaum describe an investigation of its efficiency as a drying agent. The temperature of dehydration of the boric acid was found to be an important factor, and if heated above 800° the product showed an induction period before the absorption of moisture began, indicating the probable formation of molecular complexes as suggested by Myers. Boric oxide appears to be a more powerful drying agent than sulphuric acid and calcium chloride, but is inferior to phosphorus pentoxide and magnesium perchlorate. It remains efficient until the water content rises to about 25 per cent of its own weight, this amount of water corresponding approximately to that required for the formation of metaboric acid. The glassy boric acid anhydride is more easily ground if it is obtained granular by pouring in the fused state into carbon tetrachloride at 0°.

The Twelfth International Geographical Congress.

THE twelfth International Geographical Congress, after several days in London devoted chiefly to social functions, met in Cambridge on July 17–25 for the communication and discussion of papers. The president was General N. Vacchelli, and the vice-presidents were General Gomez Nuñez and Prof. N. Yamasaki. Three commissions appointed by the International Geographical Union at a previous congress presented reports. These were on: (1) the International map on the scale of 1 : 1,000,000; (2) rural habitation; and (3) Pliocene and Pleistocene terraces. The first of these has completed its work, but the other two have still a considerable amount of work to undertake, that on terraces comprising only a study of certain European seaboards. Another report presented was on internal drainage areas, which was accompanied by a map prepared by Prof. E. de Martonne and L. Aufrère. The papers were grouped into six sections. Some of the sections were very full, while others, notably biological geography, had few papers.

In Section A (Mathematical Geography, Surveys, and Maps) papers were read on two important new atlases. The International Atlas of the Touring Club of Italy, described by Prof. G. Bognetti, will have English, French, Spanish, and German translations, besides the original Italian edition. The New Atlas of Egypt, described by Hussein Sirry Bey, has the whole country on the million scale and several new climatic and population maps.

In Section B (Physical Geography) a number of papers on climatic changes included one by Prof. J. W. Gregory, in which he argued that the evidence of physical geology and palæontology showed that the climate of the earth has been remarkably stable throughout the past. Geology gives no evidence of a uniform climate over the whole earth, and the claims for tropical conditions in the Arctic, based on fossil plants, are inconsistent with the cold sea of the contemporary marine deposits. He held that geographical changes in the distribution of land are adequate to account for local changes in climate that may have occurred.

Prof. J. L. Myres, in a paper on the climate in prehistoric Greece, found evidence of considerable variations in temperature and humidity in the past from movements of peoples as deduced by ethnology, and changes in architecture and clothing. Prof. G. B. Barbour, speaking on the nature and origin of loess in China, said that the confusion surrounding the problem of the origin of loess has arisen from a failure to distinguish between three types of superficial deposit: (1) Tertiary residual clay; (2) true loess of middle Pleistocene, a wind-driven deposit; and (3) younger gravel and loess beds in process of formation by the action of wind and water. Only the finest material has been carried from the interior of Asia across the frontier of China. Coarser debris is fixed by the vegetation of the mixed marginal belt.

In a paper on the tilting of the land blocks in Japan, Prof. N. Yamasaki described his measurements of movements in the littoral province of Echigo on the coast of the Sea of Japan, where two mountain blocks are separated from each other by a low plain of depression. Precise levellings were carried out in 1894 and 1927, and showed that both the blocks had subsided, during the interval, 2 mm. to 113 mm. The depression decreases from west to east until it reaches its minimum near the east end of each block and then increases suddenly to its maximum. Thus the movement is a tilting with the scarp in the east. This scarp coincides with a pre-existing fault.

Prof. P. Fourmarier spoke on the origin of the hydrographic system of the Congo. This cannot be adequately explained as the progressive draining of a great basin. It is the outcome of complex tectonic movements beginning in Jurassic times by the elevation of a ridge separating the Congo basin from that of the Zambezi, and later by the elevation of ground to the north and east of the basin, thus forcing the water to flow west. Com. L. Mancini explained the active steps that are being taken by Italians in oceanographical and geophysical researches in the Red Sea.

In Section C (Biological Geography) the papers dealt mainly with zoological distribution. Prof. G. Negri urged the importance of further study of the ecology of plants and animals in mountain areas, and the section was in favour of a committee being appointed to investigate this matter and report to the next congress.

Section D (Human Geography) was opened by Sir Halford Mackinder, who in a short address on the content of philosophical geography restricted the study to the distribution of phenomena within the limits of the hydrosphere, that is to say, the totality of waters on the earth, whether in ocean, air, clouds, glaciers, rivers, or percolating underground. Prof. M. Amer discussed some problems of the population of Egypt. The change from the old basin system of irrigation to the perennial system has made Egypt dependent on a single crop, cotton, and led to the necessity of importing foodstuffs. This change has been accompanied by a rapid increase in population, so great that all available land will be occupied by the seventies of this century. The rate of increase is exceeded only by that of the United States. In discussing the causes of rural depopulation, Dr. S. Vere Pearson directed attention to the loss of nitrogenous fertilisers of human origin which through the introduction of water carriage system of sanitation are lost to the soil. Thus the natural fertility of the soil is decreased.

In Section E (Historical Geography) there were a number of useful papers on the history of cartography and old maps. Section F was devoted mainly to regional geography. One of many valuable papers was by Dr. K. Uchida on the distribution of cultivated land in Japan. The cultivated area of Japan proper is only about fifteen per cent of the country, but supports half the families. Ground suitable for rice supports the highest density, and therefore the tendency is to cultivate rice wherever possible.

A lecture by H.R.H. the Duke of Apulia described his experiences in the little known Tripolitanian Sahara. An address by Dr. W. Atwood, of Clark University, on the place and functions of a graduate school of geography, outlined conditions of work, staff, and equipment, that showed forcibly how far British geography and the appreciation of geographical work have to go in Great Britain before they can reach the level of attainment in the United States. After the congress a number of long-distance excursions took place to various parts of England and Wales.

Gas, Coal, and Tar Research.

NEW research laboratories of the Gas Light and Coke Co. at Fulham were opened on July 26 by Sir Richard Threlfall; the ceremony was preceded by a luncheon at the Company's head office at Westminster, and was followed by an exhibition of apparatus and methods, and by visits to the experimental plant.

Like many a common word in the more primitive languages, the term 'research' bears a number of different shades of meaning according to the varying circumstances of its use. In its use of the term the Gas Light and Coke Co. intends that it shall cover the most careful and strictly scientific examination, both on a small and on an impressively large scale, of every phase of the production, application, and possibilities of their products; further, that it shall include the laying of a sure foundation for the future conservation of our national coal supply. Generous as the company has been in the endowment of research, the new development is not philanthropic in its conception, except in so far as it indicates a sense of public responsibility. Since the company decided to expend considerable sums of money in re-housing part of its scientific staff, and providing them with the most modern forms of apparatus so as to facilitate their functions both of control and of original inquiry, it is to be presumed that it is convinced that this course is what is generally called a 'sound business proposition.' Not only does benefit accrue to the company itself, and thus to its 20,000 co-partner employees, and to every one of its 1,250,000 customers, but also valuable support is rendered to the State in its examination, on a national basis, of similar problems.

It may be said, perhaps with truth, that the prospect of cheap electricity is not without its influence on the progressive activities of the gas industry; if such is the case, it is well that the margin available for competition between the two forms of power should be explored without delay. Probably the gas industry has yet sufficient breathing space before cheap electrical power becomes a serious competitor. Another and perhaps more immediate problem, and one to which the Gas Light and Coke Co. proposes to give closer attention in its new laboratories, is that of low temperature carbonisation. Briefly, the position, which is not uncontroversial, is as follows. Gas companies normally distil coal at a high temperature, because by so doing they obtain a high yield of gas of satisfactory quality; the tar, the composition of which is now fairly well known, yields valuable pure compounds useful, for example, in the manufacture of dyes and drugs. Moreover, the coke can be used for making power gas or carburetted water-gas, or for domestic consumption in special kinds of stoves. Meanwhile we continue to use raw coal in millions of domestic hearths, polluting the atmosphere with foul smoke, and ignoring the fact that this objectionable material proclaims the loss of a potential source of wealth. If, however, the coal is distilled at a low temperature, a rich gas is obtained in smaller quantity, and the 'coke'—which still contains 10 per cent of volatile matter—forms a smokeless fuel which can be burned in ordinary grates. The tar fraction, however, differs markedly from ordinary tar, being much more complex, and as Prof. Morgan said in his paper on the subject at the recent Chemical Industry Conference, this material has been studied only since the War. Naturally, the new method of carbonisation has its own problems concerned, for example, with the type of retort, the caking of the fuel, and the suitability of the gas for ordinary use. Such, among others, are problems which the Gas Light and Coke Co. has undertaken to study.

THE LUNCHEON.

Nearly two hundred guests were entertained by the Company to luncheon. The Governor, Sir David Milne-Watson, who presided, said that the gas industry was founded upon, and is carried on by means of, the process of high temperature carbonisation; whilst the new process of low temperature carbonisation needed careful investigation, the older process still presented many questions which invite scientific inquiry. One of the chief problems was that presented by the tar fraction. The research laboratories would be separate from works control, but would be in close touch with that control and with practice. The Mayor of Fulham, Alderman W. J. Waldron, welcomed the improvement which had been effected, saying that it was clear that the company was in close touch with the march of progress, and that the country had good reason to be proud of its work. The company recognised the double duty of service to the public and consideration for its employees. Fulham, he declared, would probably find itself in the future in the centre of the struggle for supremacy between electricity and gas.

SIR RICHARD THRELFALL'S SPEECH.

During the course of his speech, Sir Richard Threlfall said: "Inventions such as the use of fire were made before records were kept, but we have copious records of later inventions, and very likely the earlier ones came about in a fundamentally similar way, as assumed and put forward by Charles Lamb in his Dissertation upon Roast Pig. First comes the chance observation by an individual gifted enough to seek for its implications, then the attempt to reproduce the phenomena by copying the original apparatus, then the attempt to distinguish essential from unessential parts of the process leading to a working theory, and finally the improvement and simplification of the operation under guidance of the theory, which itself is subject to continual extension and improvement. . . . The early gas companies were kept busy for many a year in competing with each other, in extending their distribution system, in a perpetual struggle with municipal authorities and even with parliamentary committees, and had not any great margin of funds at their disposal; moreover, their technical personnel was not, in general, of the highly educated speculative inventive class. During the prosperous days of the nineteenth century the gas industry, like many others, did not devote much time or money to work for the future."

Sir Richard then proceeded to outline the circumstances involved in the birth and development of the Department of Scientific and Industrial Research, with which he has continuously been associated, and referred to the part it has played in finding properly equipped young men to carry on its investigations. "I have gradually come to the conclusion," he said, "that there is plenty of raw material among the young men and women of this country, which only needs reasonable encouragement to form the personnel of a large research army. In short, the parents of this country must be assured that science as a profession is worth following from the financial point of view before their sons and daughters will be allowed to embrace a scientific career." Attention was also directed to the qualities which a successful laboratory director must possess, and to

the contrast between the facilities which are nowadays enjoyed in the pursuit of science and those which were available fifty years ago.

THE LABORATORIES.

There are three principal laboratories, a conference room and library, and an office, together with a number of subsidiary laboratories—including an optical laboratory, a photographic dark room, and a thermostat room—as well as rooms containing service plant, and store rooms. The services comprise high- and low-pressure gas, coal gas (as distinct from the mixture of coal gas and carburetted water-gas), compressed air, vacuum, water, steam, and electric power at 220 and 2–15 volts d.c. A special workshop for making experimental apparatus will be included in the second half of the building, to be erected later. No. 1 laboratory (2700 sq. ft.) is to be used exclusively for general chemical research; ample space has been left for movable tables, and there is an adjacent balance-room. No. 2 laboratory, reserved for technical and semi-large scale work, is being kept as free as possible from fixtures. No. 3 laboratory will be used partly for research and partly for the chemical control of the operations carried out at the Fulham works. The products of low-temperature carbonisation tests at Richmond will also be examined at Fulham.

For the occasion of the visit there had been arranged a comprehensive display, with explanatory notes, of apparatus and methods which are employed in the research and control work. Although it is possible to mention only a few examples, it was everywhere evident that much intelligent thought and care had been devoted to the exhibition. In No. 1 laboratory were to be seen apparatus for micro-combustion and gas analysis, the determination of the vapour pressure of naphthalene, the thermal decomposition of methane and ethane, the sampling of gases, pyrometry, the analysis of coke and pitch, and the cracking of gas oil. In No. 2 laboratory were demonstrated the recovery of benzol from coal gas by activated carbon, the combustibility of coke, and refractory materials. No. 3 laboratory was devoted to a representation of the dehydration of gas and its influence on corrosion, the analysis and density of gas, and the tests appropriate to the analysis of gas oil, benzol, coal, coke, tar, ammonia, sulphur, and naphthalene. The basement contained various types of calorimeter, optical apparatus, and plant. The visitors were also conducted over the experimental gas-producing plant, where high-temperature horizontal retorts were in operation, together with condensers, purifiers, sampling apparatus, speedometers, calorimeters, etc., an experimental tar still, and a Salermo low-temperature retort.

University and Educational Intelligence.

LONDON.—Dr. Alexander Robertson has been appointed as from Sept. 1 to the University readership in chemistry tenable at East London College. From 1922 until 1924 he was Carnegie research scholar at the University of Glasgow, and was awarded a Ramsay Memorial Fellowship but resigned in order to accept a Rockefeller Inernational Science Fellowship for study at the Universities of Manchester and of Graz. Since 1926 he has been assistant lecturer in chemistry at the University of Manchester. He has published papers in the *Journal of the Chemical Society* on sabinol, pyrylium salts of anthocyanidin type, the synthesis of anthocyanins, and the syntheses of glucosides.

The title of professor of morbid anatomy in the University has been conferred on Dr. G. W. de P. Nicholson, in respect of the part-time post held by him at Guy's Hospital Medical School. The title of professor of bacteriology in the University has been conferred on Dr. Alexander Fleming in respect of the part-time post held by him at St. Mary's Hospital Medical School. In 1919 and 1923 Dr. Fleming was Hunterian professor, and in 1928 Arris and Gale lecturer of the Royal College of Surgeons; since 1920 he has also been lecturer in bacteriology in the Medical School of St. Mary's Hospital.

In view of Mr. S. A. Courtauld's munificent gifts for the Institute of Biochemistry and the Medical School of the Middlesex Hospital, the title of the University chair of biochemistry tenable there has been changed to "Courtauld Chair of Biochemistry in the University of London."

The following doctorates have been conferred: D.Sc. in chemistry on Mr. S. Guhasarkar (Imperial College—Royal College of Science), for a thesis entitled "The Influence of Groups and Associated Rings on the Stability of certain Hetrocyclic Ring Systems"; D.Sc. in geology on Mr. M. R. Sahni (Imperial College—Royal College of Science), for a thesis entitled "Studies in Jurassic and Cretaceous Terebratolids (Morphological, Evolutionary, and Zonal)"; D.Sc. in mathematics on Mr. Theodor Estermann (University College), for a thesis entitled "(1) On the Representations of a Number as the Sum of Three Products; (2) On Certain Functions represented by Dirichlet Series; (3) On a Problem of Analytic Continuation"; D.Sc. (Engineering) on Mr. John Hollingworth (Imperial College—City and Guilds College), for a thesis entitled "The Propagation of Radio Waves"; D.Sc. (Engineering) on Mr. G. A. Hankins, for a thesis entitled "*A.* A study of the Methods used in Determining the Hardness of Metals. *B.* Experiments on the Behaviour of Metals under Alternating and Repeated Stresses," and other papers.

MANCHESTER.—The Council has accepted the resignation of Dr. Alex. Robertson, assistant lecturer in chemistry, on his appointment as reader in chemistry in the East London College, University of London; and also of Dr. P. W. Clutterbuck, demonstrator of chemical physiology, on his election to a Beit memorial fellowship for medical research.

Miss Eleanor M. Jackson has been appointed demonstrator in chemical physiology.

THE trustees of the Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1928–29 to Mr. J. J. Green, of the Royal College of Science, London.

THE Aitchison Memorial Scholarship of the value of £36, open to all comers and tenable for two years in the full-time day course in technical optics at the Northampton Polytechnic Institute (London), is being offered. The examination will be held on Oct. 1 and 2. Full particulars can be obtained from the honorary secretary and treasurer, Mr. Henry Purser, 42 Gray's Inn Road, London, W.C.1.

THE ninth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation, N.Y. It deals with institutes of legal medicine, and descriptions are given of the principal continental institutes, such as those of Paris, Berlin, Vienna, Cracow, Rome, and Lisbon. In striking contrast to the fine buildings and spacious accommodation commonly provided abroad for the subject, Great Britain is singularly deficient in this respect, and is represented in the series by the two relatively small departments provided at Edinburgh and Glasgow.

Calendar of Customs and Festivals.

August 5.

ST. JAMES' DAY (O.S.).—It has been suggested that the custom of resuming the eating of oysters on this day is to be connected with the use of their shell in the small erections of shells, pebbles, and flowers known as 'grottos' still to be seen on the pavements of London, for which gifts are asked by children with the request to 'remember the grotto.' These shrines have been attributed to the cult of St. James; but from the use of the shells and the importance of the oyster in British culture, as indicated by early references to British pearls, it might be inferred that the erection of the grotto marks an ancient propitiatory ceremony of a water deity upon whom such an important article in the early food supply as shell-fish was dependent.

August 6.

In Egypt, until recently, certain ceremonies were always observed at the cutting of the dams which released the waters of the Nile to flood the land. In Cairo this took place on some date between the sixth and the sixteenth day of August. These ceremonies marked the critical character of this period of the year for a country in which, in ancient as in modern times, the prosperity depended on an adequately high Nile. That this was recognised from the remotest times is indicated by the fact that these ceremonies were related to the heliacal rising of Sirius about the time when the river was at its lowest, and did not vary with the calendar, as did other religious feasts, which, owing to the inaccuracy of the Egyptian calendar even after the intercalation of five days in the solar year, completely traversed a year in the so-called Sothic cycle of 1460 years. The high antiquity of the cult of Osiris, the deity associated with the introduction of corn into Egypt, is evident from the fact that at the tomb of Osiris at Philae the number of cups filled daily with milk was 360, corresponding with the days of the year before intercalation.

It is evident that out of a fertility cult there grew a conception of the marriage of Isis and Osiris symbolic of the fertilisation of the land by the waters of the Nile. It is possible that at one time this conception had a more material representation in the sacrifice of a human being to the waters of the river. In the ceremony as it was performed in modern Cairo, a dam was constructed near the entrance of an ancient canal, which traversed the native quarter, just before the waters began to rise. On the outer side of this was erected a truncated cone of earth on the top of which a few grains of maize or millet were sown. This was known as the 'bride.' It was washed away by the rising waters a week or more before the dam was cut. This would support the tradition that it was once the custom to throw a maiden, gaily attired, into the waters to secure a plentiful flow of water.

In modern times money for which the people dive is thrown into the canal, and it is recorded by Seneca that at a place known as 'the Veins of the Nile,' near Philae, it was the custom for the priests to throw money and gold into the waters at a feast which took place at the rising of the waters. The 'wedding' of the Adriatic with a ring by the Doge of Venice and the Epiphany customs at the river-side in eastern Europe of the present day afford instructive parallels.

August 11.

ST. ATTRACTA, virgin and patroness of Killaraught, Co. Sligo. (Fifth or sixth century.) A saint whose acts (unauthenticated) afford sufficient ground for the conclusion that her legend enshrines a tradition of some pagan goddess. Especially noteworthy are her foundation of a 'house of hospitality' at the junction of seven roads; the vigour with which she cursed St. Connall when he refused to allow her to erect an oratory near his church, and her slaying of the monster of Lugna, a dragon which was devastating the country of King Bec, whose troops she afterwards saved when pursued while on a raid, conducting them in the manner of Moses through the divided waters of a river.

August 12.

ST. MOLAISE OF LAISREN, patron of Innismurray, Co. Sligo. (Sixth century.) Beyond the record in the 'Feilire' of Aengus, the list of Irish saints, and an annexed scholion that he was "the son of Declain of Inis Muiredaig in the north," nothing is known of this saint. His probably true character is that of an embodiment of a pagan cult. The island with which he is associated is celebrated in Irish legend and further contains a large number of remarkable antiquarian remains. These include a statue of the saint himself, which, significantly enough, is believed by the peasantry to be the work of Goban Saor, the traditional master craftsman of Ireland. In addition there is a stone fort or cashel of unmortared stone; the oratory of St. Molaise, a primitive structure with walls of remarkable thickness, a 'Church of the Men' and a 'Church of the Women,' surrounding the former being the Cemetery of the Men'—in which no woman could be buried, but if she were her body was removed by unknown hands—a 'Church of the Fire' of the fourteenth century, but thought to stand on the site of an earlier structure, a number of 'hole stones' and rude font-like stone objects known as *bullauns*, and two holy wells, that of St. Molaise being covered with a beehive-like structure of stones.

THE HARVEST.—Among primitive peoples, just as among the peasantry of civilised countries, the harvest is a time of sociability and rejoicing. Though the religious element may be present, it is sometimes unduly stressed by students primarily concerned with that particular aspect. An example among the American Indians of the south-west United States is the dance held in August, or so late as early September by the Havasupai of Arizona, which in times of plenty is made the occasion of issuing invitations to the surrounding tribes of Hopi and Navajo, that they may share in the abundance and at the same time have an opportunity for trade. The feast may last for as much as three days and nights.

The dancing usually takes place towards evening as the day begins to cool, the earlier part being taken up with feasting, and on the third day with horse racing, or in these days foot-racing, and trading. The children before the dance prepare a square, in the centre of which a pole is set up. As those who are to take part arrive they take up their station around the square, the women apart from the men. On the afternoon of the first day food is served out and an exhortation is addressed to the assembly by one of the chiefs. The dance, in which both women and men take part, circles around the chief, who stands in the centre facing the pole with a singer, usually though not necessarily, a medicine man, who wears a coyote or fox skin pendent from his belt, has a broad band of brown paint across his eyes, and carries a drum. A peculiar feature of the dance is the function of a boy, disguised with a grotesque mask and grotesquely painted, whose duty it is to compel non-participants to join in the dance, beating the reluctant with switches. He appears just before or at midnight.

Societies and Academies.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 2, 1928). —**B. A. Fedorovič**: Multi-coloured sandstones of the Crimea. Pliocene deposits in Crimea are partly continental, partly marine in origin, and their fossil fauna presents evidence of considerable fluctuations in the climate of the Pliocene period.—**A. Frank-Kamenetzky** and **N. Waksberg**: Hydrochemical investigations of hot springs at Lake Baikal. Three hot springs studied belong to the category of thermal springs. In two of them the temperature of the water is 43-44° C., while in the third it is above 70°. The water is not strongly mineralised, but contains 15-30 per cent of silicic acid.—**N. Olenev**: Classification and geographical distribution of Ixodoidea. Notes on synonymy, morphology, and distribution of nine species of the genus *Hæmaphysalis*, including two new species. The distribution of *Hyalomma syriacum* is the same as that of its hosts, terrestrial tortoises of the genus *Testudo*. A doubtful species, *...odes arenicola* Eichwald 1830, is probably a synonym *Hyalomma ægyptium* L.—**N. M. Kulagin**: A contribution to the biology of *Tylenchus scandens* Schn. ...e wheat nematodes have been found recently in ...ny localities of Russia, always in galls, and never ... grain, as recorded by other authors. More than ...o thousand young nematodes were reared from one ...ll. Dried nematodes survived at temperatures up ... 88° C., but nematodes in water died at 50°.

Comptes rendus, No. 3.—**P. Lazarev**: The applica...n of Le Chatelier's formula of viscosity to solutions ... gelatine. Figures for the viscosity of gelatine ...tained by Loeb ("Proteins and the Theory of ...lloidal Behaviour." New York, 1922, p. 204) are ... good agreement with those given by the Le ...atelier's formula.—**P. Lazarev**: The importance of ...e curve of visual adaptation in diagnosing nervous ...seases. The interrelationship between normal and ...ak vision may be calculated by the aid of the ...mula $A_s/A = ES^2_1/E_1S^2$, where E and E_1 represent ...e perceptive ability of the nervous endings, S and S_1, ...e sharpness of vision in the normal and near eye ...spectively.—**S. A. Jakovlev**: The connexion of the ...sin of the Baltic Sea with that of the River Volga ...ring the postglacial period. A study of the geo...gical formations and of levelling data shows that the ...st-glacial basin corresponding to the Baltic Sea ...tended eastwards and included Lakes Beloozero, ...ipus, Ladoga, Ilmen, and some others; further ...search may show whether the basin extended right ... the Volga.—**V. N. Zvetkov**: Two new species of ...egarines from Gammaridæ from Lake Baikal. ...scriptions of *Gregarina acanthogammari* sp.n., from ...e stomach of *Acanthogammarus godlevskii* var. ...*tori* Dyb., and of *Gregarina baicalensis* sp.n., from ...e stomach of *Pallasea brandti* Dyb.—**I. D. Kurbatov** ...d **L. I. Ignatova**: The chemical composition of a ...llow active mineral from Ferghana. A yellowish ...ystalline mineral from Ferghana exhibiting certain ...tivities has been analysed quantitatively and ...oved to contain 9·74 per cent of V_2O_5 and 28·24 per ...nt of U_3O_8; its formula is $CaO(UO_3)_2.V_2O_5.+H_2O$.

VIENNA.

Academy of Sciences, May 3.—**R. Weiss** and **V. Knapp**: The action of phthalyl chloride on ...-methoxy-benzoic acid and *m*-cresol-methyl-ether. —**E. Späth** and **H. Bretschneider**: The active ...mponents of Paracoto bark. Synthesis of proto...otoin and of methyl-proto-cotoin.—**F. Hecht** and **E. Körner**: The thorium content of Katanga pitch-blende.—**E. Körner** and **F. Hecht**: Contributions to the method of chemical analysis of uranium pitch-blendes. Lead was separated electrolytically, thorium by means of sodium subphosphate, uranium by hydroxylamine and chlorhydrate in ammoniacal solution.—**A. Smekal**: The conductivity of solid silver iodide and copper iodide and the homogenation of mixtures of these two substances. The ions are regarded as sometimes taking part in the crystal lattice, sometimes free and migrating.—**O. Sickenberg**: A siren from the Leitha chalk of the Burgenland.—**K. Singer** and **O. Deutschberger**: Contributions to the physiological and pathological chemistry of the brain (2). The phosphatides and galactosides of the petrol ether fraction of the normal human brain. The distribution of these substances through the separate sections of the brain is very irregular. The galactoside content is less in the human than in the horse's brain. The nitrogen content of the brain declines rapidly in the fœtal but more gradually in the child's brain.—**Karl Singer**: (3) The phosphatides and galactosides of the petrol ether fraction of the brain in progressive paralysis and in cachexy. The nitrogen content expressed as a percentage of the dry weight was deduced; the nitrogen distribution in the petrol ether fraction showed a reduction of cholin nitrogen to about one third of normal and only traces of galactosid nitrogen.—**F. Lieben** and **G. Ehrlich**: The behaviour of aldol in the animal body and in fresh organ pulps. Aldol may be in great part consumed in the organism or built up to glycogen. In organ pulps, aldol is destroyed partly by way of β-oxy-butyric acid.—**I. Mayr**: The germination and early development of the mistletoe, *Loranthus europæus*.—**K. Menger**: Theory of convexity.—**R. Wager**: Prefloration formulæ.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 6, June).—**Alvin B. Cardwell**: The photo-electric and thermionic properties of iron. A narrow strip of electrolytic iron was suspended inside a nickel receiver, the whole being enclosed in a pyrex tube with a quartz window through which radiation from a quartz mercury arc could be admitted. Photo-electric sensitivity increased suddenly and decreased again as outgassing started; afterwards it rose in abrupt steps to a maximum. For outgassed specimens, the variation of sensitivity with temperature is complex, showing changes in the neighbourhoods of transition temperatures; the thermionic curve also shows a change near 910° C.—**R. A. Millikan** and **G. Harvey Cameron**: Evidence for the continuous creation of the common elements out of positive and negative electrons. (See NATURE, July 21, p. 111.) —**William Duane**: The general X-radiation from mercury vapour. Electrons are directed at right angles on to a stream of mercury vapour, and the radiation in the line of motion of the electrons and at right angles to this has been examined photographically and with an ionisation chamber. With a potential less than is required to excite the line spectrum, the ionisation effects show that neither beam is homogeneous, but both are of the same order of intensity per mercury atom. The experimental results for penetration of the radiation are in good accord with calculations based on the inverse square law for the distribution of energy in the spectrum.—**A. W. Simon**: On the quantity of electricity discharged in a lightning stroke. From the work of Norinder and of Peek, surface and volume charges are calculated. The potential gradient just before

the lightning flash is 6410 volts per cm., and the quantity of electricity discharged in a flash is of the order of 10 coulombs.—**Myrl N. Davis**: Secondary electrons from cobalt. A cobalt target was placed in the path of a primary beam of electrons, and the secondary electrons went to a cylinder immediately in front of the target. The ratio of secondary to primary current was plotted against accelerating potential for different periods of outgassing and heat treatment, and curves which are considered to be characteristic of cobalt were obtained. Cobalt gives much greater secondary emission than any other metal yet examined.—**Carl Barus**: Sparks of the induction coil between mucronate electrons. When one of a pair of needle points connected with the secondary of an induction coil is replaced by the tube of an interferometer U-gauge, it is found that there is a tendency to reach a definite electric wind pressure just before nearly linear sparks pass.—**Robert E. Burk** and **David C. Gillespie**: The adsorption kinetics for molecules attached at more than one point. If a molecule adsorbed on a surface is linked to more than one atom, desorption may not occur in one stage; doubly attached molecules would come off the surface at the same rate as singly attached molecules only in special circumstances. This may account for 'differential' heats of adsorption, in which it is found that the heat evolution varies during the process of adsorption.—**Robert N. Pease** and **Paul R. Chesebro**: Characteristics of homogeneous, exothermic gas reactions. Packing the reaction tube with clean fragments of pyrex glass has a marked inhibitory effect on the oxidation of hydrogen and iso-butane, and on the condensation of acetylene and ethylene. In these reactions, the accumulation of energy in molecules of the product seems to lead to miniature explosion waves (reaction centres), which, as they develop, produce a cumulative effect; the presence of packing limits development, the energy of the reaction centres being absorbed and distributed to the surroundings.—**John W. Gowen**: On the mechanism of chromosome behaviour in male and female *Drosophila*.—**Clyde E. Keeler**, **Evelyn Sutcliffe**, and **E. L. Chaffee**: Normal and 'rodless' retinæ of the house mouse with respect to the electromotive force generated through stimulation by light. Moist thread electrodes were used, one on the cornea and the other in the animal's mouth. Pigmented and albino mice with normal retinæ gave potentials very similar to those obtained with frogs, rabbits, human beings, etc., on stimulation with light. 'Rodless' animals (both pigmented and albino) gave no response. Hence, if electrical response is a necessary concomitant of vision, 'rodless' eyes are blind.—**G. Y. Rainich**: Radiation and relativity (1). An investigation from the special relativity point of view of a particle moving with the velocity of light, following the methods by which a material particle is studied.—**Willem J. Luyten**: On the absolute magnitudes of the Class *M* stars.—**Joel Stebbins** and **C. M. Huffer**: On the constancy of the light of red stars, with forty new variables of this class. 164 *M*-stars have been compared systematically with 165 *K*-stars as standards, using the photo-electric photometer attached to the 15-in. refractor at the Washburn Observatory. The *M*-stars show a tendency to variability with increasing redness, and also with increase of absolute magnitude. The very red stars may thus be termed the younger stars, with an irregular output of radiation; with time the variation probably keeps within definite limits. As these stars contract and grow hotter, they pass over to the steady *M*-state, and then on to the yellow class, *K*.—**Franz Boas**: Family traits as determined by heredity and environment. Observations of Central European immigrants to the United States show that head form and other traits are subject to environmental influences. A method is developed by which the non-hereditary elements may be distinguished from the hereditary elements.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society of Edinburgh, Session 1927–1928. Vol. 48, Part 2, No. 10: The Law of Blackening of the Photographic Plate at Low Densities. (Third Paper.) By Dr. E. A. Baker. Pp. 106–133. 1*s.* 6*d.* Vol. 48, Part 2, No. 11: Salmon (*Salmo salar*) of the River Moisie (Eastern Canada) 1926 and 1927. By P. R. C. Macfarlane. Pp. 134–139. 1*s.* Vol. 48, Part 2, No. 12: An Analysis of Preferential Voting. By D. M. Y. Somerville. Pp. 140–160. 2*s.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Royal Observatory, Greenwich. Declinations of Stars derived from Observations of Transits in the Prime Vertical with the Altazimuth in the Years 1923–26, under the Direction of Sir Frank Dyson. Pp. v+64. (London: H.M. Stationery Office.) 7*s.* net.

Newport Public Libraries, Museum and Art Gallery. Fifty-eighth Annual Report and Balance Sheet for 1927–28. Pp. 14. (Newport, Mon.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 13, Technological Series No. 8: Research in Cotton Technology in India, 1927. By A. James Turner. Pp. iii+86. 1 rupee. Bulletin No. 14, Technological Series No. 9: The Effect of Different Spindle Speeds on the Results of Spinning Tests. By A. James Turner. Pp. ii+22. 1 rupee. (Bombay.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 25. Edited for the College by Dr. S. Graham Brade-Birks. Pp. 251. (Wye.) 8*s.* 6*d.*; Residents in Kent and Surrey, 4*s.* 6*d.*

Empire Marketing Board. May 1927 to May 1928. (E.M.B. 9.) Pp. 64. (London: H.M. Stationery Office.) 1*s.* net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1133 (Ae. 303): Full Scale and Model Measurements of the Lift and Drag of the Bristol Fighter with M.2 Section Wings. By E. T. Jones and A. S. Hartshorn. (T. 2554.) Pp. 8+8 plates. 9*d.* net. No. 1142: Report of the Symbols Committee. (T. 2521 and *A*.) Pp. 4. 3*d.* net. (London: H.M. Stationery Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 379, July. Pp. 669–804+xxxii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 3, No. 3, July. Pp. 179–269. (Cambridge: At the University Press.) 12*s.* 6*d.* net.

FOREIGN.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 17, No. 1: Notes on Lower Tertiary Deposits of Colombia and their Molluscan and Foraminiferal Fauna. By F. M. Anderson. Pp. 29 (1 plate). Vol. 17, No. 2: New Mycetophilidæ taken in California and Alaska. By M. C. van Duzee. Pp. 31–65. Vol. 17, No. 3: A Key to the Species of Eucalyptus grown in California. By Eric Walther. Pp. 67–87. Vol. 17, Nos. 4 and 5: Tertiary and Pleistocene Mollusca from the Galapagos Islands, by William Healey Dall and Washington Henry Ochsner; Landshells of the Galapagos Islands, by William Healey Dall and Washington Henry Ochsner. Pp. 89–139 (plates 2–7)+141–185 (plates 8–9). Vol. 17, No. 6: West American Mollusca of the Genus Phasianella. By A. M. Strong. Pp. 187–203 (Plate 10). (San Francisco, Calif.)

American History in terms of Human Migration. Extracts from Hearings before the Committee on Immigration and Naturalisation, House of Representatives, Seventeenth Congress, First Session, March 7, 1928. Statement of Dr. Harry H. Laughlin. With Three Appendices. Part of Hearing No. 70.1.5. Pp. iii+21. (Washington, D.C: Government Printing Office.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 23. (New York City.)

United States Department of Agriculture. Miscellaneous Circular No. 46: A Bibliography of the European Corn Borer (*Pyrausta nubilalis* Hbn.). By J. S. Wade. Pp. 35. (Washington, D.C.: Government Printing Office.) 10 cents.

Field Museum of Natural History. Report Series, Vol. 7, No. 2: Annual Report of the Director to the Board of Trustees for the Year 1927. (Publication 248.) Pp. 175–376+plates 21–41. Anthropology Leaflet No. 27: The Giraffe in History and Art. By Berthold Laufer. Pp. 100+9 plates. 75 cents. (Chicago, Ill.)

Department of the Interior: U.S. Geological Survey. Bulletin 788-E: Topographic Instructions of the United States Geological Survey. E: Topographic Mapping. By W. M. Beaman. Pp. vi+161–378+viii+plates 8–28. 50 cents. Water-Supply Paper 579: Power Capacity and Production in the United States. Papers by C. R. Daugherty, A. H. Horton and R. W. Davenport. Pp. ii+210+4 plates. 80 cents. Water-Supply Paper 596-H: Notes on Practical Water Analysis. By W. D. Collins. (Contributions to the Hydrology of the United States, 1927.) Pp. ii+235–266+plate 14. 10 cents. Professional Paper 150-D: Sedimentary Rocks of the San Rafael Swell and some Adjacent Areas in Eastern Utah. By James Gilluly and John B. Reeside, Jr. (Shorter Contributions to General Geology, 1927.) Pp. ii+61–110+plates 15–21. 25 cents. Professional Paper 150-E: The Pocono Fauna of the Broad Top Coal Field, Pennsylvania. By George H. Girty. (Shorter Contributions to General Geology, 1927.) Pp. ii+111–127+plates 22–23. 10 cents. Professional Paper 150-F: Notes on Pleistocene Faunas from Maryland and Virginia and Pliocene and Pleistocene Faunas from North Carolina. By Wendell C. Mansfield. (Shorter Contributions to General Geology, 1927.) Pp. ii+129–140+plates 24–25. (Washington, D.C.: Government Printing Office.)

SATURDAY, AUGUST 11, 1928.

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No. 3067, Vol. 122]

Empire Agricultural Research.

THOSE engaged in agricultural research cannot complain that the authorities take no interest in their subject ; in fact, attention has grown to an extent that is almost embarrassing, as the official reports on various aspects of agricultural research that have been issued in the past few months bear witness. We may mention the report of the first Imperial Agricultural Research Conference, the report on the Colonial Agricultural Service (itself a corollary to two previous reports on the same subject), the Empire Marketing Board's account of its second year of work, and finally the Royal Commission on Agriculture in India, the report of which has been reviewed recently in our columns.

The Imperial Agricultural Conference stressed, both explicitly and by inference, the essential unity of agricultural research throughout the Empire ; the differences, no matter how large they appeared on the surface, were of degree and not of kind. It is therefore particularly opportune that the Colonial Office and Indian reports should have appeared almost simultaneously, since each gives in some detail the organisation proposed for the efficient conduct and extension of research work within the regions in question.

The recommendations are almost identical, and the significance of this is enhanced when the difference in the constitution of the recommending bodies is considered : the Colonial Office Committee included members with expert experience in agricultural research, while the Indian Commission, owing no doubt to its extensive terms of reference, was composed mainly of members having general rather than special experience. The expert and the man with general training are so often in conflict on matters of policy that the agreement in this case, reached independently and by consideration of quite independent conditions, is strong evidence that the recommendations are sound.

To summarise them very briefly, an Advisory Council is proposed on which various interests are represented, with a layman of wide administrative experience as chairman, and two or more permanent officers who will be agricultural scientists of standing, and deal with soils and crops, and animals respectively. The success of the Council's work is recognised to depend very largely on the ability of these scientific advisers to stimulate research work, to suggest new activities, to co-ordinate and to prevent overlapping in the services and institutions over which the Council has advisory functions. Improvements are outlined in organisation, status, and prospects for members of the agricultural

services, and although the details vary widely in the two reports because of the difference in conditions, the intentions are the same: to encourage first-class research workers to enter the agricultural services, to pay them adequately, and to avoid so far as possible any water-tight compartments between different institutions and areas.

The proposals give rise to a number of important points. The Colonies and India will have adequate organisation for research, but what of the rest of the Empire? Australia is making generous provision both from the Commonwealth and State funds; the Council of Scientific and Industrial Research—a body that has similar functions to the Department of Scientific and Industrial Research in Great Britain—is putting into effect a bold and extensive policy. Canada has had for some time an agricultural service that incorporates the most successful features of the United States' organisation. South Africa has moved forward rapidly in recent years, thanks to a far-sighted policy of scholarships that attracted the most promising of its young graduates in pure science. It may fairly be said that, except for the absence of an Advisory Council constituted exactly as outlined above, the agricultural services in these three countries follow in essentials the scheme contemplated by the Colonial Office Committee and the Indian Commission.

This leads to the second point: is it feasible to extend to the whole Empire the elastic organisation for research contemplated for the non-self-governing Dependencies? In other words, is it possible to have administrative machinery that would effect a worker's transfer from, say, Australia to South Africa, or Great Britain to India, with no more difficulty than from Kenya to Nigeria? It is self-evident that anything approaching a unified Empire Agricultural Service is outside the realms of possibility. The whole tradition and policy of the Empire is towards independent development and administration of its constituent parts. Nevertheless, fundamental agricultural research cannot pay any tribute to political divisions. Deficiency diseases of animals occur in many parts of the Empire, while irrigation problems do not exist only in India. If we regard the matter from the point of view of the problems in fundamental research, it may truthfully be said that a unified agricultural service is already in being, and the question becomes resolved into the simpler and practicable one of ensuring that the experience and results obtained in any part of the Empire are available to any other part.

It is desirable to deal with this point in some detail. There is a natural tendency among administrators to conceive of this as a problem that can be met by an organised interchange of scientific papers, by supplying from a central organisation competent summaries of the present position in a given branch of agricultural research, by issuing full details of new experimental methods, and so on. Such a service would be of great value, especially to the man in the remote parts of the Empire, but it is not his main requirement. He already obtains—usually at his own expense—scientific journals, and he probably conducts a fairly extensive private correspondence with other men engaged on similar work to his own. Although he would welcome any arrangement that supplied him automatically with scientific literature, he needs above all things the opportunity, at the appropriate stage in his work, of personal contact with investigators in his own subject. He may have carried his work to a point where it can only be completed with the resources or the help of some other station, or he may wish to discuss all his data with another worker. His desire, therefore, is for study leave in its widest sense. The need is a universal one; it is felt as much by those enjoying the resources of a well-equipped institution as by the isolated workers.

Any scheme by which this personal contact could be secured would remove one of the greatest obstacles in the path of research workers. By virtue of their position the home authorities have here a special opportunity; and there are already in existence two methods that could be developed to give the desired end. These are the Imperial Agricultural Research Conference and that section of the activities of the Empire Marketing Board that deals with research.

The Research Conference has met only once. The organisation was admittedly experimental, and the delegates came from all branches of the agricultural service. The discussions were correspondingly wide, ranging from research problems through agricultural practice to matters of pure administration. Although there is undoubted advantage in holding a joint conference for those concerned in these three groups, there can be no question that the main value to research workers is in meeting one another, and indulging to their hearts' content in the gentle pastime of picking one another's brains. The success of the conference, even in its experimental form, resulted in a decision to hold a second conference in five years' time in Australia. This is a long interval, but it has one advantage. It allows adequate time for the

careful selection of problems for discussion and for the governments to appoint as delegates those directly concerned in research on these problems. This was not done—indeed it could not be done—for the first meeting, and in some instances delegates from abroad were selected because they were due for leave in any case. It is to be hoped that for future conferences the home authorities will be able to secure the consent of Overseas governments to send the appropriate delegates.

The second direction in which the home Government can help is through the Empire Marketing Board. Although the Board has only been running a short time, it has been peculiarly effective in furthering basic research work both at home and overseas. Its Research Grants Committee has taken an admirably broad view of its functions, for, in addition to financing definite investigations, it is actively exploring the scheme for a chain of central research stations, approved in principle by both the Imperial Conference of 1926 and the Colonial Conference of 1927. It is evident that this proposal contains the possibility of providing some of the fluidity that an Empire Agricultural Service would give. The Board recognises that no cut-and-dried scheme is possible: "Its accomplishment must be an affair of many years and of patiently won experience." An exceedingly encouraging sign to all concerned in research is that the Board is determined to create the stations around the research problems. There is so often a fatal tendency, when money is available, to build an elaborately equipped station, and to collect a staff, who are then instructed in a vague way that they are to begin 'research.' It is not possible to produce advances in science like castings out of a mould. The outstanding research worker is singularly little affected by environmental conditions, be they good or bad. If he is to be used for the best advantage of agriculture, some elasticity of terms of service is essential in order that he may get at grips with the problem that really interests him. A chain of research stations should provide the desired outlet for the best men, who are always few in number.

We have necessarily dealt in some detail with problems of organisation, and it is well to stress once more the grave danger of over-organisation. Research will not give of its best within a fixed framework. The research worker must be free to change the whole plan of his research if conditions demand it. He is not in the least afraid to change horses in mid-stream—it is, in fact, the usual prelude to a solution of his problem. In this his work differs from all forms of political administration, and the administrator who was foolish enough to emulate the research worker's methods would achieve, not success, but a revolution, or at least a riot.

Finally, we would direct attention to one other aspect. The reports on which we have commented deal almost entirely with overseas agricultural research. Great Britain possesses, thanks to the Ministry of Agriculture and the Development Commission, a comprehensive and efficient scheme of agricultural research. Its members have had considerable experience in the difficulties of research, and an encouraging degree of success in their efforts to advance agricultural science and practice. As a result their services are being sought by other organisations, and the exodus from the service to better paid posts has already begun. A steady movement of men to other posts is highly desirable, for it prevents stagnation and brings in new blood. If the proposed developments in the Colonial Empire become an accomplished fact, the demand on the home service for men will be greatly increased, and it may even reach a level that will seriously impair its efficiency.

Egyptian Mathematics.

La science égyptienne : l'arithmétique au moyen empire. Par O. Gillain. Pp. xvi + 326. (Bruxelles : Reine Elisabeth, 1927.) n.p.

"HABENT sua fata libelli." The most valuable original document representing the ancient Egyptian mathematics is still the Papyrus Rhind in the British Museum. This papyrus was written at some time between 1788 and 1580 B.C. by a scribe called Ahmes, Ahmesu, or Ahmose, who says that he copied it from an earlier document, to which we may assign a date as early as 1842 to 1801 B.C. Whether it is a pupil's notebook or rather (as M. Gillain suggests) a book of exercises put together for his own amusement by some amateur who was drawing upon his recollections of study at school, but had at hand for reference some manual from which he could make extracts at will, it contains nothing but quite elementary matter, and is, moreover, disfigured by mistakes which show that the scribe at any rate was no mathematician. Yet (while advanced works such as the Porisms of Euclid have perished) fate has preserved this book, and after some 3700 years it is still being actively discussed (it is true that it was only acquired by A. H. Rhind at Luxor in 1858 and was not published until 1874). M. Gillain's bibliography contains the titles of between forty and fifty books or

memoirs dealing with Egyptian mathematics in general or the Rhind Papyrus in particular; and opinions are still sharply divided.

In the handsome volume before us, M. Gillain, while noticing the other original sources (limited to about five, including the Moscow Papyrus not yet published), devotes himself mainly to an elaborate analysis and elucidation of the contents of the Rhind Papyrus. Hitherto the idea has been that the whole of the work in the Rhind has an empirical rather than a theoretical basis; Gillain's object is to prove that the Egyptians had a good grasp of theory as well. He deduces from a number of examples of a certain type the rule on which the solver must have proceeded, and argues that the statement of the rule itself was only omitted because it was well known to everybody. We may concede that the Egyptians had a number of definite rules for the practical working of problems, and to that extent had grasped the principles as well as practice; and Gillain has performed a service in bringing out this fact.

Save in a few exceptional cases of multiplication by 3 and 10, the Egyptian performed his multiplications by successive doubling. He first wrote down the multiplicand, and then below it, successively, twice, four times, eight times, sixteen times it, and so on, writing 1, 2, 4, 8, 16 . . . in a column alongside the products; lastly, he selected powers of 2 which (with or without the addition of 1) made up the multiplier and added the corresponding products. This method of multiplication by successive doubling persisted through the centuries; Michael Stifel used it (1525); and it is still worth while to point out that the 'Russian peasant' system of multiplication which came up as a curiosity a few years ago is only a very handy way of carrying out precisely the same process.

It is characteristic of the Egyptian notation that they had a sign for $\frac{2}{3}$ but for no other fractions except submultiples or aliquot parts (fractions, such as $\frac{1}{3}$, $\frac{1}{8}$, $\frac{1}{29}$, with unity for numerator). When, therefore, their calculations led to ordinary fractions with numerators exceeding unity, they had, before they could write them down, to decompose them into sums of submultiples; this was much facilitated by a regular table, which is set out in the Rhind, giving the decomposition of all fractions having 2 as numerator and the odd numbers from 3 to 99 as denominators (the scribe says "divide 2 by 5," "divide 2 by 17," and so on). The question then arises, had the Egyptians any conception of ordinary fractions such as $\frac{5}{18}$? One recent writer (Neugebauer) apparently maintains that they had not. Prof. Eric Peet, in his recent fine edition (1923), thinks that this by no means follows from the mere fact that they could not write such fractions; and Gillain has now proved conclusively, not only that the Egyptians had a clear conception of ordinary fractions (though they could not write them down), but that they thoroughly understood the operations of adding a number of such fractions or subtracting one from another by bringing them to a common denominator (though the common denominator was not necessarily the least common multiple of the denominators, but might be a smaller number provided that all the numerators could be expressed in integers with submultiples, *e.g.* $3\frac{1}{8}$), and of multiplying two such fractions, and finally that they realised that to divide by a certain fraction meant multiplying by that fraction turned upside down.

Division was performed by means of successive tentative multiplications carried on until the sum of the partial products equals the dividend. (Incidentally it must be said that our division is no less tentative, though, with our notation, it is easier.) The successive multipliers are first 2 and its powers, and, when we have used as many of these as are necessary, we have to find and use fractional (*i.e.* submultiple) multipliers. It is in the course of this operation that it becomes clear that the Egyptian had a clear idea of a fraction in the more general sense and knew how to use it. As a simple case, take the division of 2 by $1\frac{1}{3}+\frac{1}{4}$. (Here the quotient is less than 2, so that the product by 2 does not appear.) The Egyptian writes:

'	1	$1\frac{1}{3}+\frac{1}{4}$	228
	$\frac{2}{3}$	$1\frac{1}{18}$	152
	$\frac{1}{3}$	$\frac{1}{2}+\frac{1}{36}$	76
'	$\frac{1}{6}$	$\frac{1}{4}+\frac{1}{72}$	38
'	$\frac{1}{12}$	$\frac{1}{8}+\frac{1}{144}$	19
'	$\frac{1}{228}$	$\frac{1}{144}$	1
'	$\frac{1}{114}$	$\frac{1}{72}$	2
Total . .	$1+\frac{1}{6}+\frac{1}{12}+\frac{1}{114}+\frac{1}{228}$		

It is to be observed that the Egyptian places a mark on the left of the particular multipliers which contribute to the total of the quotient; the column on the right shows clearly that he has reduced the fractions in the first five lines of the second column to the common denominator 144, the numbers 228, 152, 76, 38, and 19 being the resulting numerators. Now it is plain that, after the partial product representing $\frac{1}{12}$ of the divisor, the Egyptian considered how much of the dividend (2) remained. For this purpose he used the numerators in the

third column, referring to 144 as the common denominator. Referred to the same common denominator, 2 represents 288; he therefore subtracted from 288 the sum of 228, 152, 76, 38, and 19, which gives 3. Therefore $\frac{3}{144}$ is the portion of the dividend remaining over. As $\frac{1}{8}+\frac{1}{144}$ corresponds to $\frac{19}{144}$, he can clearly obtain $\frac{1}{144}$ by dividing by 19. He accordingly takes $\frac{1}{19}$th of $\frac{1}{12}$, giving $\frac{1}{228}$ in the first column. The remaining $\frac{2}{144}$ he gets by doubling, thereby obtaining $\frac{1}{114}$ in the first column. Thus the total of the quotient is $1+\frac{1}{8}+\frac{1}{12}+\frac{1}{114}+\frac{1}{228}$.

The grasp of the Egyptians over the handling of fractions is further shown by the exceptional case of the division of 1 by $3\frac{1}{3}+\frac{1}{5}$. Here, instead of taking once, then $\frac{1}{2}$, then $\frac{1}{4}$, of $3\frac{1}{3}+\frac{1}{5}$ and so on, in the usual way, so as finally to make up 1, the Egyptian evidently in his mind turned the expression $3\frac{1}{3}+\frac{1}{5}$ into $\frac{106}{30}$ by reducing to 30 as common denominator (he might have made the common denominator 15). Then he recognised that to divide 1 by $\frac{106}{30}$ is the same thing as to multiply 1 by $\frac{30}{106}$. Accordingly he sets to work to find, as a sum of aliquot parts, the result of dividing 30 by 106, thus:

	1	106
	$\frac{1}{2}$	53
′	$\frac{1}{4}$	$26\frac{1}{2}$
′	$\frac{1}{106}$	1
′	$\frac{1}{53}$	2
′	$\frac{1}{212}$	$\frac{1}{2}$

Here, after arriving at $26\frac{1}{2}$, he considers how to work up to a total of 30 in the second column. The deficiency is $3\frac{1}{2}$. He can evidently get 1 by dividing the first line by 106, and then 2 and $\frac{1}{2}$ by doubling and halving respectively. The total quotient is thus $\frac{1}{4}+\frac{1}{53}+\frac{1}{106}+\frac{1}{212}$.

Gillain gives a satisfactory account of the probable method by which the Egyptians arrived at the various decompositions into submultiples of the fractions which we should write as $\frac{2}{5}, \frac{2}{7} \ldots \frac{2}{99}$. When he comes to the 'hau' calculations, he finds sometimes simple division and sometimes the equivalent of the 'rule of three' where others have seen the method of 'false hypothesis' only. He gives a thorough analysis of this set of problems as well as of the isolated cases of arithmetical and geometrical progression occurring in the Papyrus, and of the various problems of measuring the content of certain vessels, including the parallel case of the cylinder in the Kahun fragments. The book is to be recommended as a thoroughly sound exposition of the subject. T. L. H.

An Indictment of War.

Will Civilisation Crash? By Lt.-Comdr. the Hon. J. M. Kenworthy. With an Introduction by H. G. Wells. Pp. 320. (London: Ernest Benn, Ltd., 1927.) 10*s.* 6*d.* net.

IN this volume by Commander Kenworthy we are reminded of the homicidal tendencies of the constituent parts of the white race, the aggregate effect of which, if unrestrained, must be race suicide and the end of the present phase of civilisation. During the War, latent resources, inherent in civilised man's growing dominion over natural forces, were only partly mobilised in the attempt at self-annihilation. Even so, the rapid development of the mechanical side of war, the enhanced efficiency of the aeroplane as a destructive agent, the invention of land ironclads, the almost incredible increase in the range, accuracy, and mobility of the guns of the heavy artillery, and the use of poison gas, liberated from cylinders or projectiles, had given the armies in the field and civilian populations a foretaste of horrors to come, sufficient, it might be thought, to have created a common will for the outlawry of ordeal by battle.

Most of us who had any experience of warfare thought that once it was over the peoples of the world—particularly the combatant nations—would join together in a mighty effort to repair the ravages of those four and a half years' insanity, and with a more intense zeal and greater wisdom than they had misapplied science would apply the discoveries, the methods, and the outlook of science to the task of making the world more habitable for the human stock. We imagined that Great Britain was pre-eminently fitted to give the lead in this direction. Instead, our politicians provoked an orgy of emotionalism, one section of our countrymen clamoured for the further punishment of the wretched peoples who were unfortunate enough to have been born in and fought for Germany, while another section indulged in hysterical hero-worship of those peculiar individuals in our midst who had refused to share the common burden of citizenship. Statesmen of all nations pandered to the worst passions of the mob and disregarded the solemn warnings and advice of the wise. 'Thieves kitchen' mentality determined policy. Incalculable harm was done to the future peace of the world.

The result is that Europe is now menaced by the existence of a multiplicity of armed camps. Asia is insurgent, Africa is restless—there are ominous murmurings in Morocco, in Abyssinia, in Egypt and the Sudan—and the United States of

America, practically self-supporting, with no obvious enemy, is persuaded that it must occupy the rôle filled by Germany before the last war, and threaten our naval supremacy. Instead of the spirit of militarism having been exorcised, it is now the most powerful influence in international relationships, and has extended to the spheres of industrial and social relationships in each civilised country. The present situation is summed up by Mr. H. G. Wells in a characteristic preface to this book: "I clung to the delusion that at the end of four years of stupid, clumsy, and inconclusive massacre and destruction, the common sense of mankind would say quite definitely 'never again' to any such experience, and would be prepared to revise its ideas of nationality, empire, loyalty, race competition and propagation, soundly and effectively as soon as it could for a moment struggle out of the mud and blood and reek in which it was entangled. . . . My mistake was in attributing any common sense to mankind."

Any survey of the greater part of Commander Kenworthy's subject matter would probably be considered as lying outside the legitimate scope of this journal. Most scientific people prefer that their political appetites should be satisfied by dishes seasoned to their tastes. They, like other men, have their instinctive prejudices, and feel the same sense of irritation at having them exposed as irrational. In their specialised fields of science they could not suffer the partial or subjective treatment of facts, but they obstinately refuse to believe that domestic or international relationships are the concern of science, that the habit of thought inculcated by the study of science should influence their civic as well as their scientific activities. They would be dismayed at the suggestion that the International Research Council should enter the political arena and prepare a memorandum for the Great Powers setting forth in detail the effect of the intensive application of modern scientific discoveries to warfare, or the ameliorative and progressive effects of the proper and thorough application of scientific principles to the production and world-wide distribution of essential commodities. The rationalisation of the world's industries, the essential requirement for world peace, will probably eventually be accomplished because of science, but unless there is a remarkable change of attitude on the part of scientific workers, they will play a very minor part in the determination of policy which brings it about.

Any scientific worker, however, who takes the trouble to read Commander Kenworthy's masterly survey of the present world situation is certain to be struck by the poverty of statesmanship revealed, and with the need for a different kind of leadership. He will be constrained to ask, Who is responsible for the fact that the most civilised nations of the world are spending more time, energy, and thought on preparations for another war of attrition than they are on the development of the world's natural resources? Why is it that the governments of Great Britain and the United States are spending considerably more on naval armaments than they are prepared to devote to the improvement of the social and industrial conditions of their peoples? He may reflect that Great Britain is spending more of the national income on scientific research in connexion with its fighting services than it is on research applied to the development of the potential resources and industries of the Empire: that it haggles over a few millions to be devoted to the construction of railways and roads in the immense tropical territories in its possession, but never seriously challenges greater expenditure on a single battleship, which in any case would be more useless in a future war than in the last: that it spends large sums on training its fighting leaders, but leaves the leadership of industry to chance circumstance: that it makes every endeavour to keep its fighting personnel in a state of efficiency, but does nothing to prevent large numbers of its industrial workers from losing their skill.

The only answer to this indictment is that other nations follow the same tradition, and no one nation dare break with it, least of all our own: that the code of ethics determining individual relationships cannot be applied to international relationships. While we accept this as axiomatic, war remains a possibility, and "nations cannot be blamed for arming themselves with all the resources of science and invention." On our part we must prepare the most effective devices for the wholesale slaughter of our enemies, particularly their civilian populations, because victory in the next war, even more so than in the last, will be achieved by bringing pressure to bear on the enemy populace. We must have command of the air, enormous fleets of aircraft which can be mobilised within a few hours to rain high explosives and lethal bombs on the industrial centres of enemy nations, to destroy their docks, railway centres, arsenals and aerodromes, and to cripple their war-vessels, including their aircraft carriers. As an alternative means of defence we must increase the efficiency and number of our submarines,

and be prepared to strew minefields about every enemy harbour. If we cannot exorcise the war spirit, we must be prepared for the adoption of still more appalling methods of destruction, for example, the liberation of disease germs: already, for this purpose, the systematic study of the most effective means of spreading pestilential diseases is being pursued in the laboratories of more than one country. Tanks and first-class battleships can be left out of our calculations: they would be useless if the other weapons enumerated were perfected.

Commander Kenworthy has fairly accurately diagnosed the causes of war between nations—albeit he ignores one possible cause, the facility with which the force of mob discontents can be diverted from the government responsible to other governments—but his proscription for the prevention and cure of war is even less convincing than his palliative, which is to make war more decent by the abolition of submarine warfare. The only road to peace, he avers, is for "war to be declared a crime and be no longer recognised, in any way or at any time, as a legitimate method of settling international disputes." As Mr. Wells says in the preface, "the ending of war is a far more complex, laborious, and difficult task than mere gesticulations as this imply. A great change is needed in the teaching of history and the training of the young citizen, a substitution of a biological for a merely economic and political conception of human life, before we can begin to hope for the secure establishment of those world controls upon which alone an enduring world-peace can be sustained."

A. G. CHURCH.

Theories of Capillarity.

Kapillarität und Oberflächenspannung. Bearbeitet von Prof. Dr. G. Bakker. (Handbuch der Experimentalphysik, herausgegeben von W. Wien und F. Harms, Band 6.) Pp. xv + 458. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 44 gold marks.

PROF. BAKKER has made a very important addition to the literature of capillarity. The author is an authority who has spent upwards of a quarter of a century in mathematical research on the theory, and in the thoroughness and balance with which the mathematical theories are treated his book is probably without an equal. It may well remain the standard text-book on those theories, such as Laplace's, which treat the liquid as a continuum diminishing in density near the surface. In many other branches, also, the subject is dealt with in great detail. There are good chapters on the thermodynamics of surfaces, on the geometrical forms assumed by liquid surfaces, on the measurement of surface tension, and on the numerical results of these measurements. The account of the theory of the various methods of measurement of surface tension is probably unique in its fullness; there are very few omissions, and those only in detail. The researches on the molecular structure of surface films are also given lucidly and thoroughly; this rapidly growing section, however, suffers markedly from lack of attention to literature more recent than 1924. It seems almost a pity that some kind of 'stop-press' notice could not here have been given to developments at least as young as two years old, even if the bulk of the work required four years—as it very well might, so thorough is the treatment—to bring into shape.

Electro-capillarity is not treated, and angles of contact are not explained in terms of adhesions between solid and liquid, an explanation which seems to the reviewer to make them intelligible. The author also follows the usual practice of mathematical treatises of overlooking the experimental fact that the contact angle can have any value between two widely different extremes, according to the tendency of the liquid to move on the surface. This variation of contact angle is a frictional phenomenon between solid and liquid, and it is so far from recondite that it may well be known to any intelligent child who watches drops of rain trickling down an ordinarily dirty window-pane. Its importance for the theory of capillarity is no less than that of friction for statics; and to neglect it experimentally must result—indeed has often resulted—in disaster. Yet its existence is seldom, if ever, even hinted at in the mathematical theory.

The appearance of this book may well mark the end of an epoch in the theory of capillarity. Molecules are dominant in nearly all other branches of physics, and they are finding their way into capillarity. They can probably never be fitted into the 'classical' theory, for its structure will scarcely admit any particle so coarse as the molecule is known to be. An important mathematical operation in the classical theory is the application of infinitesimal calculus in a direction perpendicular to the surface, in the region of 'diminishing density'; but since it is practically certain that, if there is a diminution of density, the transition is all over in at most three molecules thickness, the physical meaning of this operation is very obscure. But

the classical theories are not alone in the field; there is now another which harmonises with the rest of modern physics and chemistry. In 1913, Hardy initiated a molecular, chemical theory, and in 1917, Langmuir gave it definite shape. The molecules are in the forefront of the picture, and the macroscopic phenomena are explained in terms of the fields of force of these molecules; moreover, these fields of force are shown to be identical with those which give rise to chemical reactions of all kinds.

All recent developments have shown the great unifying power of this theory; not only has it been the basis for the accumulation of a great deal of knowledge of the two-dimensional state of matter occurring in surface films, but it has shown that the formulæ of organic chemistry really represent the shapes of the molecules, and it has made clear the relations between capillarity, organic chemistry, and crystallography. Beside this living, powerful theory, the classical 'continuum' theory of Laplace seems little more than a mathematical game. Though we need to keep and use the thermodynamics and the calculations of the manifold effects of surface tension—the tendency of liquids to diminish to minimum area—unless the pendulum of physical theory makes an altogether unexpected swing back to continuity instead of discontinuity as the basis, the non-molecular Laplacian theory cannot contribute much to the advancement and unification of knowledge.

These are criticisms of the classical theory, not of its presentation in this book. That could scarcely be bettered; and it is well to have the work of the last century so ably put together. The only danger is lest possibly the reader should feel that the important theories of capillarity are somewhat apart from the rest of physics, and the mathematician inclined for constructive research should fail to realise that the molecular theory of capillarity is in existence, and needs his aid very urgently.

N. K. ADAM.

Commercial Seed Production.

Seed Production and Marketing. By Prof. Joseph F. Cox and George E. Starr. (The Wiley Farm Series.) Pp. xviii + 450. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 20*s*. net.

OF cultural books on gardening and farming there are plenty, and the enthusiast is well provided for, whether his hobby be the growing of vegetables, sweet peas, roses, or choice flowers from seed. But the art of raising new and improved varieties of plants, and the successful production of commercial seed, are subjects upon which comparatively little literature has ever been published, and the vast majority of those who grow or handle flowers or vegetables have little, if any, idea of how the different types and varieties originated, or how seeds of them are produced true to type.

The commercial production of choice strains of seeds is a highly technical business, often dabbled in by amateurs, to their own cost, and understood in its various branches by really few seed-growing experts. It is true that many gardeners or farmers have at some time had experience in the saving of seed of one or more subjects, but to be able to produce good seeds, true to type and of high germination, of the many thousands of varieties listed in seedsmen's catalogues, is a real achievement, and requires long years of careful study and observation. Consequently, any book which will give the garden-loving public even a small idea of how all this work is done, is sure to be welcomed, and read with very great interest.

The new book just issued by Prof. Cox and Mr. Stair is without doubt the best and most complete work on this subject which has been published, and every chapter shows a good acquaintance with the different methods adopted. In the raising of new plants, the modern method of 'single line' selection is described in conjunction with the older one of 'mass' selection, and the effects which are obtained by cross pollination between different varieties give the general reader some idea of the great care necessary in isolating seed crops of different subjects. In every branch of Nature there is a tendency towards degeneration, and an excellent illustration shows how skilled men have to walk carefully over seed crops to detect and remove every plant which shows any variation from the true and improved type. The practical seed grower will find many hints and much information which will be of value to him in the planting, 'rogueing,' harvesting, threshing, and cleaning of the seed, whilst there are many articles and tables of value to the seed merchant.

The book is well written and well printed, and although it is undoubtedly of greater value in America, because many of the subjects described, such as maize, cotton seed, soy beans, cow peas, squashes, peppers, tobacco, lettuces, okra, etc., cannot be seeded commercially in Great Britain, yet it is well worth a place on the bookshelf of anyone interested in the subject on this side of the water.

WALTER F. GILES.

Our Bookshelf.

Chemical Affinity. By L. J. Hudleston. (Monographs on Inorganic and Physical Chemistry.) Pp. vii + 138. (London: Longmans, Green and Co. Ltd., 1928.) 7*s.* 6*d.* net.

THIS useful little monograph has a somewhat misleading title. It would scarcely be expected that a book on the subject of "Chemical Affinity," published in these days when so much is coming to light about the nature of chemical action, would omit all reference to mechanism and confine itself solely to the discussion of the thermodynamics of the subject. With this limitation, however, the author has written a work which will fill a place in the teaching of the subject, and has certainly attained a considerable measure of success in the task which he set himself, namely, to show the practical importance for research and for modern industry of thermochemical methods of approach to chemical problems.

After two comparatively short chapters on classical thermodynamics, Lewis's development of the free energy conception is fully discussed both in relation to the behaviour of pure substances and in the more difficult field of solutions. It is, in fact, as an exponent of Lewis's methods that the author writes, but any criticism of the book on the ground of excessive weight given to this side of the subject is sufficiently rebutted by consideration of the demonstration of the great usefulness of Lewis's treatment of the subject for practical purposes. The chapter which follows on the heat theorem is perhaps too brief to give a student a full comprehension of the importance of the advance made by Nernst. The most useful part of the book is its concluding chapter, in which examples of the application of modern thermodynamics to laboratory and industrial problems are worked out in detail by the aid of energy data which are tabulated in a valuable appendix. These examples will, we venture to think, do more to convince the student of the usefulness of thermodynamics than much disquisition.

A few errors could profitably be corrected in a new edition. On p. 18, "increased energy" is an obvious slip for "increase in the energy," and in the derivation of the heat theorem d/dT of $aTlnT$ is inadvertently given as $alnT$. It would also assist the ready comprehension of the chapter on free energy if the conceptions of heat content and free energy were referred to as new 'functions' introduced by Lewis and not 'terms,' an expression which tends to confusion when introduced into a discussion plentifully adorned with equations.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 6: Chlor. Pp. xvi + xiv + 442. (Berlin: Verlag Chemie G.m.b.H., 1927.) 68 gold marks.

IN the volume on chlorine the high standard of excellence reached in the preceding numbers is well maintained, the literature having been exhaustively reviewed up to June 1927. In accordance with the general plan of the work, the volume deals only with the element itself and with such compounds as it forms with the few elements which precede it in the scheme. After a brief account of the history and occurrence of chlorine, its preparation, manufacture, and physical properties are discussed at great length. The attack upon the problem of the separation of the isotopes of chlorine by several different methods is carefully recorded and an instance is quoted of an unusually high value found by Madame Curie for the atomic weight of a sample obtained from an African desert salt. Otherwise the remarkable constancy in the proportions of the isotopes affords evidence of the enormous antiquity of the existing ratio. Then follows an account of the structure of the atom, the dimensions of the molecule, and the various thermal, optical, electrical, and electrochemical properties, and a preliminary survey of the chemical behaviour of the element towards water, non-metals and metals, and a summary of quantitative methods of analysis.

The remaining four-fifths of the volume is devoted to a consideration of compounds of chlorine. Eight diagrams are reproduced, including those indicating the existence at low temperatures of different hydrates of hydrogen chloride and of perchloric acid. The chemical, physical, and electrochemical properties of hydrogen chloride in the gaseous condition and in solution in water and in other solvents, and of oxides, oxyacids, chlorides, hypochlorites, chlorites, chlorates, and perchlorates have been detailed and classified with meticulous care. Lastly, nitrogenous compounds such as nitrogen chloride, chlorazide, the chloramines, nitrosyl, and nitryl chlorides have come under review, and reference is also made to the single fluorine derivative—fluoronium perchlorate. The careful style of the work and the vast number of references to original memoirs should render the work of immense value to research workers.

The Measurement of Air Flow. By E. Ower. Pp. vii + 199. (London: Chapman and Hall, Ltd., 1927.) 15*s.* net.

THE correct measurement of the flow of air in closed pipe systems as well as in the free air is of considerable importance, and the volume before us attempts the description of the various methods at present in use and the apparatus used, particularly in reference to the motion of air along pipes and ducts. Theory is introduced, as in the chapters in which the theory of the pressure tube anemometer and the vane anemometer are discussed, and in the chapters dealing with the flow through orifices, the Venturi meter and nozzles, but the emphasis is on the instrumental and experimental aspect of the subject. Chap. iii. is a valuable chapter on pitot and static tubes, the results of tests of various types being given. Such instruments only give 'point velocities,' but they are often used for determining the flow along fairly large mine headings, and some readers may be a little disappointed that no hint is given as to

the possibility of determining mean velocities in terms of certain spot readings in such cases. The author, however, does give curves showing the distribution of velocity across, and the relation between the mean and axial velocity in smooth circular pipes. The chapter on the vane anemometer is full and complete and concludes with the warning that an anemometer should not be used in a pipe the diameter of which is less than six times that of the instrument. The chapter on manometers describes particularly the instruments used in the National Physical Laboratory and will be found useful to many workers. A concluding chapter deals with hot-wire anemometers.

The work is clearly written and will enable many types of workers to obtain accurate information on the design and use of instruments for the measurement of air flow. In many works and laboratories it will be found useful as a book of reference. The bibliography will also be valuable to other workers.

Culture: the Diffusion Controversy. By Prof. G. Elliot Smith, Prof. Bronislaw Malinowski, Dr. Herbert J. Spinden, Dr. A. Goldenweiser. (Psyche Miniatures, General Series No. 18.) Pp. 98. (London: Kegan Paul and Co., Ltd., 1928.) 2*s*. 6*d*. net.

THOSE who wish for a concise statement of varied and opposing views on the 'diffusion' controversy cannot do better than invest in this little volume. Here we have the protagonists brought face to face within one cover. Prof. Elliot Smith opens with an able exposition of his views. He states the position, however, as that of two flatly opposed schools, and regards the acceptance of culture contact by the opponents of his whole theory, or more specifically of his theory of Egyptian origins, as an inconsistency, and not as a recognition of facts. But, as Prof. Malinowski shows in the contribution which follows, the opposing school which Prof. Elliot Smith and his colleagues attack is an abstraction, at any rate at the present day. To contest certain elements in the 'diffusionist' theory is not necessarily to deny the fact of diffusion. Mr. H. J. Spinden follows with a sarcastically scornful, but humorous, survey of the various Schools of Romantic Anthropologists from the time when a knowledge of Adam and Eve and the Tower of Babel was sought among the American Indians. Prof. A. Goldenweiser sums up judicially, but has difficulty in finding a single anthropologist who holds the view attributed to the tribe by Prof. Elliot Smith.

The Annual of the British School at Athens. No. 27, Session 1925–1926. Pp. x+319+30 plates. (London: Macmillan and Co., Ltd., 1928.) 63*s*. net.

SUBSCRIBERS to the funds of the British School of Archæology at Athens, and others into whose hands this volume will come, will regret the revised law of antiquities by which the activities of any one school or group of archæologists have been restricted to two sites of excavation. We miss the smaller 'side shows.' Not infrequently they were stimulating as well as illuminating. It must not be concluded hastily, however, that the present volume is lacking in matter of interest to take their place, while the sites chosen for excavation are worthy of the attention which is now concentrated on them.

The continued excavations at Sparta in 1925–26, which is the chief operation of the School, are here described by the Director; but for the moment interest centres on the work of Mr. Heurtley in Macedonia, which is throwing a flood of light on the racial and cultural movement between prehistoric Greece and the areas to the north. Mr. Heurtley here deals with his excavations at Vardaroftsa, on the banks of the Vardar, which have revealed a local culture primarily Anatolian, but in one period showing traces of northern influence, and later on of Hellenic penetration.

Mexico: Land, Volk und Wirtschaft. Von Prof. Karl Sapper. Zweite, vollständig neubearbeitete Auflage der "Wirtschaftsgeographie von Mexico." Pp. 165+15 Tafeln. (Wien: L. W. Seidel und Sohn, 1928.) 8 gold marks.

THE first edition of this book was published in 1908. The present issue has been completely revised in the light of changes in the economic condition of Mexico. Prof. Sapper writes of a country which he knows well from several visits, and he has the faculty of putting a great deal in a small compass, so that the book, though small in size, gives a comprehensive survey of the geography of Mexico and is in fact one of the most useful volumes on that country available. There are statistical and bibliographical appendices and an economic map.

An Introduction to Chemistry: for Lower Forms of Secondary Schools. By J. Morris. Pp. vii+152. (London: Methuen and Co., Ltd., 1927.) 3*s*.

MR. MORRIS'S book is rendered more than usually interesting by the historical details and short biographies of famous chemists which it contains. In this connexion it should be mentioned that Humphry Davy's name is always incorrectly given, and that the story about phosphorus on p. 131 should refer to Lemery and not Boyle, and that the ignition was accidental. The descriptive part is clearly written and does not cover too much ground, so that the book may be recommended as likely to prove both useful and interesting in junior classes.

Mathematical Preparation for Physical Chemistry. By Prof. F. Daniels. (International Chemical Series.) Pp. x+308. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 15*s*. net.

THIS work should appeal to those students of chemistry who find particular difficulty in understanding the elements of higher mathematics required in the study of physical chemistry. The ground covered is small, but great emphasis is laid on important parts, and the treatment is as elementary as possible. There are good collections of simple examples.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Combustion of Hydrocarbons: Hydroxylation and/or Peroxidation.

THE publication in NATURE of July 7, p. 19, of Mr. A. C. Egerton's recent Royal Institution discourse on "Engine Knock and Related Problems," following upon Prof. H. L. Callendar's paper on the same subject in *Engineering*, pp. 147-8, 182-4, and 210-2; 1927) about a year ago, moves me to direct attention to certain well-established facts in regard to hydrocarbon combustion which seem in danger of being overlooked in the present discussion of the subject.

It may be recalled that in the course of my researches on the subject—chiefly during the years 1900–1906, but also at intervals afterwards—some hundreds of experiments were made upon the combustion of methane, ethane, propane, *n*- and *iso*-butanes, the corresponding olefines (*i.e.* ethylene and homologues) and acetylene, each in admixture with varying proportions of oxygen, and under all conditions from slow combustion at 300° to 400° C., through ordinary flame reactions, up to detonation, including high-pressure explosions. In the 'slow combustion' experiments a number of intermediate products (chiefly aldehydes) were isolated; moreover, the products obtained when the hydrocarbons were exploded with defect of oxygen were shown to be substantially those resulting from the thermal decompositions of alcohols and aldehydes.

Therefore it was concluded that (i.) the slow oxidation of such hydrocarbons as methane, ethane, and ethylene essentially involves successive 'hydroxylation' stages with evolution of heat, accompanied by (according to circumstances) the thermal decomposition of unstable 'hydroxylated' molecules into simpler products, which may afterwards undergo further oxidation in like manner, and (ii.) although the same sequence of changes may not be reproduced exactly in flames, "the immediate result of the initial encounter between hydrocarbon and oxygen is probably much the same in the two cases, namely, the formation of a 'hydroxylated' or 'oxygenated' molecule. At the higher temperatures of flames, secondary thermal decompositions and interactions undoubtedly come into operation at an earlier stage, and play a more important rôle, than in slow combustion; they do not, however, precede the onslaught of the oxygen upon the hydrocarbon, but arise in consequence of it."[1]

For some time after discovering the intermediate formation of large quantities of aldehydes in the slow combustion of methane and ethane, I halted between two opinions as to whether the initial stage involved 'hydroxylation' or the primary formation of an oxygenated molecule:

$$\text{(i) } CH_3.CH_3 \longrightarrow CH_3.CH_2.OH \longrightarrow \overbrace{CH_3.CH(OH)_2}$$
$$H_2O + CH_3.CHO \text{ etc.}$$

$$\text{or (ii) } CH_3.CH_3 \longrightarrow CH_3.CH_3O_2 \longrightarrow H_2O + CH_3.CHO, \text{ etc}$$

[1] Discourse on "Explosive Combustion with special reference to that of Hydrocarbons," delivered at the Royal Institution on Feb. 28, 1908.

At first I was inclined to the latter view (see *Trans. Chem. Soc.*, **83**, 1075-6; 1903), supposing that the oxygen molecule would act as a whole; but as the research proceeded, a great mass of cumulative evidence eventually compelled me to adopt the former. Nor has anything recently published shaken my belief that normally, and for the most part, the combustion process is essentially one of 'hydroxylation,' although it may well be that, in the pre-flame period during the compression stroke in an engine cylinder, a small proportion of the initial molecular collisions produce an unstable peroxide, thus causing 'knocking.' From Mr. Egerton's recent publications (*Aeronautical Research Committee Reports and Memoranda*, No. 1079, issued in December 1926, and his recent Royal Institution discourse) it is not altogether clear to me whether he considers that the *whole*, or only *a part*, of the hydrocarbon burns through 'peroxide' rather than by 'hydroxylation.' It may be stated, however, that in none of my experiments (except one on the slow combustion of acetylene, where the transient formation of a substance which seemed to be a polyglycolide, $nC_2H_2O_2$, was observed) was there any sign of initial peroxide formation.

To summarise adequately the mass of experimental evidence referred to would require far more space than could be given here; but it will perhaps suffice for me to indicate in the following numbered paragraphs (with references to the original papers) a few of the more outstanding facts which must be accounted for by any comprehensive theory.

(1) In 1906, J. Drugman, working in my laboratory, showed (*Trans. Chem. Soc.*, **89**, 939; 1906) that when ethane is subjected to the action of ozone at 100° C.—at which temperature it does not react with ordinary oxygen—ethyl alcohol, acetaldehyde, and acetic acid are all prominently formed, the oxidation proceeding in successive hydroxylation stages, thus:

$$CH_3.CH_3 \quad CH_3.CH_2.OH \longrightarrow$$
$$\overbrace{CH_3.CH(OH)_2}$$
$$H_2O + CH_3.C\begin{matrix}\diagup H \\ \diagdown O\end{matrix} \longrightarrow CH_3.C\begin{matrix}\diagup OH \\ \diagdown O.\end{matrix}$$

(2) In our numerous 'bulb experiments,' in which ethane–oxygen, ethylene–oxygen, and acetylene–oxygen mixtures, respectively, reacted in closed vessels at 300° C. and pressures between about 2 and 2·2 atmospheres, there was but little to choose between the observed rapid rates of reaction with hydrocarbon/oxygen ratios of 2 : 1 and 1 : 1, although in each case any excess of oxygen beyond the equimolecular portion slowed down the rate considerably (*Trans. Chem. Soc.*, **85**, 693, 1637; 1904; **87**, 1232; 1905).

(3) The isolation of considerable quantities of acetaldehyde—doubtless arising by intra-molecular change from the unstable vinyl alcohol $CH_2 : CH . OH$—from the products of the slow combustion of ethylene (W. A. Bone and R. V. Wheeler, *Trans. Chem. Soc.*, **85**, 1653-4; 1904; also T. S. Wheeler and E. W. Blair, *Jour. Soc. Chem. Ind.*, 303T; 1922; and 81, 87, and 415T; 1923) accords much better with the 'hydroxylation' than with a 'peroxidation' view of the process.

(4) The persistent formation in all our 'bulb experiments' (*q.v.*) with methane, ethane, ethylene, and acetylene (in all of which formaldehyde was produced intermediately) of large quantities of carbon dioxide simultaneously with carbonic oxide and steam, *in circumstances which absolutely precluded* its arising either by the direct oxidation of carbonic oxide, or by its interaction with steam, could not be explained except on the supposition of its having

arisen by the oxidation of the intermediate formaldehyde in 'hydroxylation' stages, thus:

$$\longrightarrow \begin{matrix}H\\H\end{matrix}\!\!>C=O \longrightarrow \underbrace{\begin{matrix}HO\\H\end{matrix}\!\!>C=O}_{CO+H_2O} \longrightarrow \underbrace{\begin{matrix}HO\\HO\end{matrix}\!\!>C=O}_{CO_2+H_2O.}$$

(5) In experiments upon the explosive combustion of olefines it was found that, whereas when any one of those examined is exploded with oxygen in the ratio $C_nH_{2n}+\frac{n}{2}O_2$, there is no separation of carbon, and but little (if any) formation of steam, the products consisting almost entirely of carbonic oxide and oxygen, as though produced by the thermal decomposition of formaldehyde, yet *with a more limited supply of oxygen*, both carbon and steam arise simultaneously and in quantity (W. A. Bone and J. Drugman, *Trans. Chem. Soc.*, **89**, 660-682; 1906, where the matter is fully discussed). Indeed, in all such cases, the facts compel us to regard the ratio $C_nH_{2n}+\frac{n}{2}O_2$, which (except in the case of ethylene) is *not* the equimolecular, as being critical in some deep sense. According to my view, it represents the stage at which, from a 'hydroxylated' molecule $C_nH_n(OH)_n$, successive 'formaldehyde groups' may be eliminated and decomposed into $CO+H_2$ ($>CH.OH \longrightarrow CH_2O \longrightarrow CO+H_2$) without any breaking down at a *less* 'hydroxylated' stage, which would (and actually does) occur, with simultaneous production of carbon and steam, when the oxygen-supply is reduced below the ratio referred to; and anyone carefully studying such facts with an open mind will, I think, realise how incompatible they are with a 'peroxidation' view of the matter.

(6) During the course of the experiments recently carried out by Dr. D. T. A. Townend in my laboratory on the explosion of methane with up to its own volume of oxygen at initial pressures up to 150 atmospheres (*Proc. Roy. Soc.*, A, **116**, 637-663; 1927)—in which the behaviours of mixtures $5CH_4+2O_2$, $2CH_4+O_2$, $3CH_4+2O_2$, $4CH_4+3O_2$ and CH_4+O_2 on explosion at varying initial pressures were very thoroughly examined—a series of significant observations were made regarding the ratios of steam formation to the oxygen contents of the mixtures, which, while in accordance with the 'hydroxylation,' would be much more difficult to account for by a 'peroxidation' theory.

(7) The chief difficulty confronting the 'hydroxylation' theory during the earlier stages of our researches was our failure to isolate an alcohol from the intermediate products of the oxidation of a paraffin such as ethane; it diminished in weight when it was found (W. A. Bone and W. E. Stockings, *Trans. Chem. Soc.*, **85**, 722-5; 1904) that, under the experimental conditions, ethyl alcohol is oxidised much more rapidly than ethane; and it became more and more shadowy as the experiments referred to in paragraphs (1) and (2) progressed. In a recent paper by M. Stanislas Landa, "Sur la combustion lente des hydrocarbons" (*Comptes rendus*, **186**, 589; 1928), the results of experiments are described in which the slow oxidation (at 280°-300° C.) of the vapours of liquid paraffin hydrocarbons was studied with the view to discriminating between the 'hydroxylation' and 'peroxidation' theories respectively. After recording the isolation in quantity of both alcohols and aldehydes from the combustion products, the author concludes as follows: "Dès à présent les résultats que j'ai obtenus, résumés ci-dessus, constituent la première démonstration expérimentale de l'exactitude de la manière de voir de Bone sur la combustion lente des hydrocarbures. Mes recherches m'ont en effet permis d'isoler et d'identifier les alcools et aldéhydes dont la présence indique ainsi nettement le processus de l'oxydation."

In directing attention to the foregoing well-established facts, I would repeat that, while not denying the possibility of some small 'peroxide' formation occurring in the pre-flame period during the compression stroke of a petrol-air engine, and thus causing 'knocking,' I still hold that normally, and for the most part, the combustion process is essentially one of 'hydroxylation' and not 'peroxidation.' Nevertheless, as is said on p. 377 of Bone and Townend's "Flame and Combustion in Gases," "The two views are, however, not mutually exclusive, and may perhaps be supplementary; for only a very rash or dogmatic person would nowadays assert that *every* collision between hydrocarbon and oxygen molecules (or oxygen atoms) must always have precisely the same result as regards the particular 'oxygenated' molecule initially produced." WILLIAM A. BONE.

Imperial College of Science,
London, July 17.

PROF. BONE's summary of the facts in support of the hydroxylation theory of hydrocarbon combustion will be appreciated by all who are interested in the subject. As Prof. Bone notices, I have not been explicitly in favour either of peroxidation or hydroxylation. The experimental evidence does not seem to me to rule out either process completely. Once reaction has been set going homogeneously, it may proceed by a variety of paths. But *initially*, there must be some process more probable than another, and the question is, What is that process? Is the primary step to involve dissociation of the oxygen molecule, as seems to be demanded if the formation of a single OH group first occurs?

The main conclusion from the behaviour of antiknocks is that a chain reaction mechanism is set up depending on the formation of some active product which propagates the chain and which is destroyed by the 'inhibitor' (and probably also by the walls of the vessel). The behaviour of 'antiknocks' and 'proknocks' is somewhat easier to understand if the first step in the combustion process is the incorporation of a sufficiently active oxygen molecule with the hydrocarbon molecule (thereby forming what may be termed a 'temporary peroxide'), the active products formed by reorganisation or decomposition of the compound being able to continue the reaction chain. It might also be held that more than two active molecules must come together as a first step in the reaction process. That view is preferred in the case of hydrogen and oxygen by Hinshelwood and Gibson (*Proc. Roy. Soc.*, **119**, 591; 1918), rather than the collision of a single hydrogen molecule with an oxygen molecule.

Such processes as these do not involve dissociation of oxygen and liberation of a free oxygen atom, and could presumably occur more readily than processes involving dissociation. However, it must not be overlooked that the preliminary activation may not be simply thermal—hydrogen and oxygen, for example, do not readily ignite unless traces of water are present—and a small number of active centres (possibly oxygen atoms produced at the surface of the vessel) may be essential to initiate the reaction, as Semenoff concludes in the case of the oxidation of phosphorus (*Zeit. f. phys.*, **46**, 109; 1927). Further work is needed to elucidate the nature of these initial happenings for the hydrocarbons, but the subsequent consequences, it seems to me, are largely covered by the hydroxylation theory and the work which Prof. Bone did in the first years of the century. A. EGERTON.

Clarendon Laboratory, Oxford.

The Titanium Oxide Bands.

THE fine structure analysis of the blue-green titanium bands, started nearly two years ago (see *Phys. Rev.*, **29**, 212; 1927, abstract 26), has now reached the point where it is possible to draw certain definite conclusions regarding the molecule responsible for the radiation of these bands. These conclusions are based on a complete verification of the combination principle, using some 1500 lines measured in the three bands 0-0, 1-0, and 0-1 (λλ 5167, 4955, and 5448).

Each band consists of three *R* and three *P* branches. These six series are nearly, but not exactly, parallel, so that they are continually crossing and re-crossing one another. Due to this fact, almost a majority of all measured lines are blends, and this has made both the empirical and the theoretical analysis unusually difficult. Good values for the triple origin have not as yet been obtained, but the three *heads* of the 0-0 band lie at approximately 19349, 19347, and 19340 cm.$^{-1}$. These will be denoted as the *a*, *b*, and *c* heads respectively. In the case of the P_a and R_a branches, the resulting rotational energy functions fulfil quantitatively the expected relations between rotational and vibrational energy constants, and accordingly one can obtain from these functions very trustworthy values of the moment of inertia. The functions for the other two members of the triplet exhibit small positive and negative deviations respectively from the expected theoretical relations, and these deviations have not yet been satisfactorily explained.

There is no doubt that this band system is due to an oxide of titanium, and our earlier vibrational analysis (loc. cit.) showed that it is due to a diatomic molecule. The new additional fact that the individual bands have a triplet structure is practically certain proof that they are due to a molecule with an *even* number of electrons. Hence they must be due to *neutral* TiO rather than to TiO^+.

It is not possible to carry any of the series within about twenty lines of the origin, due to the close spacing and overlapping of all series in that region. Hence one cannot say definitely that no *Q* branches are present. But *if* they occur, they must be very short and weak. It is therefore very probable that these bands are due to a $^3P - {}^3P$ transition (like the Swan bands), rather than to $^3P - {}^3S$, or $^3P - {}^1S$. If TiO is similar to CO, the normal level should be ^1S, and on that assumption the lower level of these titanium bands is an *excited* level of the TiO molecule.

The values of the moments of inertia for the upper and lower levels are $(56 \cdot 76 \pm 0 \cdot 03) \times 10^{-40}$ and $(51 \cdot 87 \pm 0 \cdot 03) \times 10^{-40}$ respectively, corresponding to a nuclear separation (r_e) of $1 \cdot 694 \times 10^{-8}$ cm. and $1 \cdot 619 \times 10^{-8}$ cm. The values of r_e are approximately the same as those found for AlO, and are some 15 per cent smaller than had been anticipated for TiO, from a study of the constants of other similar molecules. Hence the TiO molecule seems to be especially firmly bound.

The two band systems of possibly major importance in astrophysics are the Swan bands, found in *R*- and *N*-type stars, and the titanium bands, found in *M*-type stars. The great preponderance of evidence is now that the Swan bands are due to a $^3P - {}^3P$ transition in the neutral C_2 molecule, while the above facts indicate that the blue-green titanium bands are due to a $^3P - {}^3P$ transition in the *neutral* TiO molecule. These two band systems, as is well known, never occur together in stellar spectra, a fact usually explained by assuming that one carrier exists in a reducing atmosphere, and the other in an oxidising atmosphere. The above conclusions are in agreement with this assumption.

A. CHRISTY.
R. T. BIRGE.

University of California,
July 7.

Two Lecture Demonstrations in Physics.

(1) Two conducting wires or rods about five feet in length are stretched in a wedge shape, the gap being one-half inch at the bottom and three-quarters of an inch at the top. The upper three feet of the wires are covered with a glass tube. It is well known that if an induction coil is connected to the two wires, the resultant sparks will be carried up the wires by the rising ions; hence the spark will seem to climb the wires. When the spark reaches the top of the glass tube, the ions go out of the end, so that the spark begins again at the bottom. If now the top of the glass tube is tightly corked, the spark when it enters the tube will travel more slowly than along the lower part of the wires, and when it reaches the cork, a layer of ions will stay there, so that the spark, instead of returning to the bottom, will remain just under the cork. With the cork removed, an air blast down the tube will either prevent the spark from climbing or will blow it down the wires.

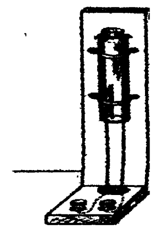

FIG. 1.

(2) Gray, in his book "Gyrostatics and Rotational Motion," has described a top which when rocked will walk in one direction along two parallel wires. When the top reaches the end of the wires, it is necessary to slide it back to its first position. If, however, the top is unbalanced with a small mass *M*, there will be an average upward force during each half revolution of the top of value $2Mv^2/\pi r$. This will lessen the friction between the wires and the top, so that the top will slide backwards on the wires, provided the wires are exactly horizontal. We have shown before that the top will walk down a pair of inclined wires, since friction on the wires will start and stop precession. Therefore a top may be rigged up on inclined wires as shown in Fig. 2. With the spring extended so that *C* is well above *B*, the top will walk from *C* to *B*. With the spring depressed so that *C* is slightly below *B*, the unbalanced top will slide back

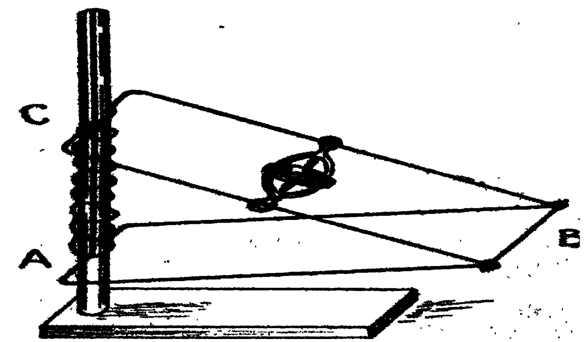

FIG. 2.

from B to C. The Hurst gyroscopic tops which we use are always slightly out of kinetic balance, so that no mass need be added to produce the backward movement.

R. C. COLWELL.
M. C. HOLMES.

Department of Physics,
West Virginia University.

Brown Coloration in Interrenal Cell Tissue.

IN a histological investigation of the interrenal of the ray (*R. clavata*), it has been found that while the majority of the glands examined correspond to the usual description of an ochre-yellow body, a minority show a brown coloration apparently due to melanin pigment. In the yellow glands the lipin has been found to be confined to the cells of the lobules which compose the organ, but in the brown glands a considerable proportion of the lipin lies in the interlobular blood-spaces. The photomicrograph (Fig. 1) taken

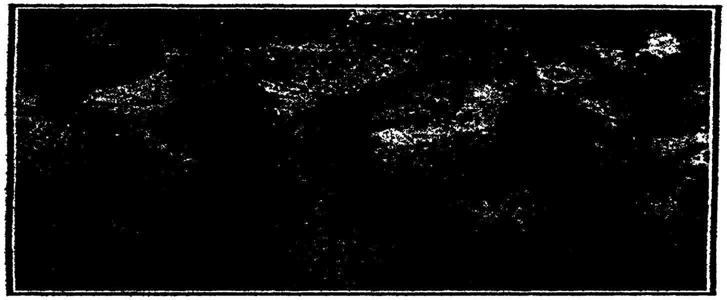

FIG. 1.—Interrenal tissue of *R. clavata*. × 500.

from a gland prepared by Marchis' method shows this quite clearly. The black masses of osmicated lipin obviously lie between the lobules. The appearances suggest very strongly that the brown glands when fixed were actively secreting lipin into the blood. The relation between lipin secretion and melanin formation is probably significant.

The results obtained confirm earlier work done on the rabbit during 1926 at the Physiology Department of the University of Aberdeen.

A demonstration of the work is being arranged for the meeting of the Society for Experimental Biology at Glasgow in September, and a full account is in preparation for publication.

ALLAN FRASER.

The Laboratory,
Citadel Hill, Plymouth,
July 13.

The Origin and Progress of Mankind.

IN the article under the above title in NATURE of July 21, I am accused by the writer "J. R." of "ignoring a broad biological principle," presumably because I was careful not to confuse the principle of "convergent evolution" with wild theories of "spontaneous generation." Yet in the very next sentence the author of the admonition somewhat inconsequently adds: "The final scientific criterion must be 'Prove all things.'"

I had hoped that by dealing in my Huxley Memorial Lecture with the history of biological and ethnological theories I might exorcise such elements of confusion. For I made it clear that the ethnological dogma of the "independent development of culture" was utterly different from the biological principle of convergence, and was in fact a survival of the pre-Newtonian type of scholasticism, which led men astray precisely because it did not insist upon the principle "Prove all things."

G. ELLIOT SMITH.

University College,
London.

THERE is no analogy between the idea that in similar circumstances similar customs and inventions may have arisen and the discredited biological theory of spontaneous generation, for at whatever stage of human development different communities, as they are known to us, may have left the main stock, they already had behind them a vast background of common experiences, of mental and social development, the basis of their further progress. Granted that as an ethnological dogma the similarity theory has been a bad master, there seems to be no reason why in its proper place it should not be a good servant, and our protest was against the danger of treating as non-existent the common background of humanity and all that it implies.

J. R.

The Instability of a Single Vortex-Row.

IT was shown by von Kàrmàn in a well-known paper that a single row of vortices equally spaced and all rotating in the same sense is unstable; but the constructive consequences of this result seem to have received less attention than the destructive ones. It is shown that a disturbance of the pattern increases with time like $e^{\lambda t}$; λ is greatest when the displacements of consecutive vortices are equal and opposite (Lamb. "Hydrodynamics," 5th edition, p. 209, equation 12). Hence the type of disturbance that develops most rapidly is one that tends to separate the row into two rows, consecutive vortices going into different rows.

Now when a stream is obstructed by an obstacle projecting into it, the free stream line at the edge of the wake degenerates into a row of eddies all of the same sense, and this can be seen to separate in the way just indicated. Some of the eddies are deviated

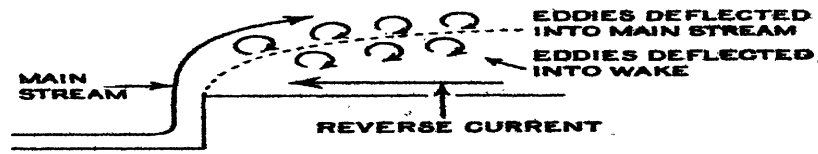

FIG. 1.

into the main stream and swept away in it, while the others enter the dead water, where they produce a circulation with a reverse current near the boundary (Fig. 1). The reverse current often noticed behind the wind screen of a motor car, behind an obstacle at the edge of a stream, or on the lee side of a hill, is thus qualitatively explicable.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

Photosynthesis.[1]

By Prof. E. C. C. BALY, C.B.E., F.R.S., University of Liverpool.

THERE is no process within the confines of chemistry which is of greater interest and importance than that by means of which the living plant prepares the food on which its life and growth depend. This food consists of starch and sugars, together grouped under the general name of carbohydrates, and of certain nitrogen-containing compounds known as proteins. The material from which the plant starts is carbonic acid, or a solution of carbon dioxide, which it obtains from the air, in water which it obtains through its roots from the soil. From this substance alone the plant is able to prepare its supply of carbohydrates, and it is true to say that this chemical process is the fundamental basis of the whole of terrestrial life. This may truly be asserted because the production of the proteins is very closely associated with it and the initial stage is common to the two.

The formation of carbohydrates from carbonic acid when expressed by a chemical equation looks simple enough. There is no doubt that the first product of the process that can be recognised in the plant is a simple sugar, and thus the equation can be written

$$6H_2CO_3 = C_6H_{12}O_6 + 6O_2$$

where the simple carbohydrate is either glucose or fructose. These simple sugars undergo condensation immediately they are formed to give cane sugar or one of the starches, and these changes can readily be written as simple chemical equations.

The mechanism by means of which the plant achieves the synthesis of these complex compounds from carbonic acid has long been a mystery to chemists and to botanists. It is known that the agency used by the plant to effect its purpose is sunlight, and thus the term 'photosynthesis' has been applied to the operation. It is also known that the plant makes use of certain pigments, such as chlorophyll, and it is to these that the colour of the leaves is due. The mystery of it all lay in the fact that no one knew what actually takes place, and, indeed, the more chemists and botanists explored, the more puzzling did the problem seem to be.

Perhaps the most puzzling fact of all is that the plant only makes use of sunlight, when all our previous knowledge of light reactions leads us to believe that such light is quite incapable of inducing photosynthesis. This may readily be understood if the amount of energy involved in the synthesis is considered. It has been proved experimentally that in order to synthesise one gram molecule (180 grams) of glucose or fructose, there must be supplied to the carbonic acid a minimum quantity of energy equal to 673,800 calories. Whilst it is known that the plant manages in some way to absorb the necessary energy in the form of light, the physicist tells us that it cannot absorb directly enough energy from sunlight. Thus the photosynthesis can be brought about by red light of the wave-length 660 $\mu\mu$ when the energy directly absorbed can only be 260,000 calories, which is far below the minimum quantity required.

The experience gained from the ordinary reactions of photochemistry leads to the belief that if it is required to convert carbonic acid into sugars by means of light alone, it will be necessary to use ultra-violet light which is absorbed by carbonic acid, that is to say, light of wave-length 210 $\mu\mu$. It is obvious from this that some unknown factor is operating in vital photosynthesis.

In any endeavour to elucidate the mystery, it is evident that the first line of inquiry must be to study the action of the short wave ultra-violet light upon carbonic acid. This was first investigated by Moore and Webster in 1913, who found no evidence of any reaction taking place. They found, however, that in the presence of certain catalysts, such as colloidal iron hydroxide, small quantities of formaldehyde were produced. Since these results appeared to be at variance with general experience in photochemical investigations, they were again examined some years later in Liverpool, and it was then found that when a stream of carbon dixoide was passed through water irradiated by the light from a quartz mercury lamp, small quantities of formaldehyde were produced. This result seemed to be very satisfactory, since the formaldehyde could be looked upon as an intermediate stage on the way to carbohydrates, especially in view of the fact that Moore and Webster had proved that formaldehyde was converted by light into substances with properties similar to the simple sugars.

Our observations were criticised by Porter and Ramsperger, who stated that if rigid precautions were taken to guard against the presence of every trace of impurity, no formaldehyde was produced. The suggestion was implied by them that the origin of the formaldehyde was to be found in some unknown impurity. There is, however, an alternative possibility, and one which is more in keeping with the known facts of the natural photosynthesis in the living leaf. There is no doubt that in this reaction the carbonic acid is converted directly into carbohydrates and that formaldehyde as such is not produced, and it seemed that the most probable explanation of the discrepancy between our results and those of Porter and Ramsperger was that the action of the ultra-violet light is to establish a photo-chemical equilibrium,

$$6H_2CO_3 \rightleftarrows C_6H_{12}O_6 + 6O_2,$$

which reverts to carbonic acid again in the dark. In the presence of oxidisable impurities a small amount of carbohydrates will be formed, which will be photochemically decomposed to formaldehyde. This decomposition of all the carbohydrates by means of ultra-violet light is well known.

There is no need to give here the details of the experiments which were carried out to test this view, and it is sufficient to say that conclusive proof

[1] Discourse delivered at the Royal Institution on Friday, Feb. 3.

was obtained of the reality of the equilibrium: that is to say, carbohydrates were found to be present in the solution during irradiation by ultra-violet light, and they vanished very quickly after the irradiation was stopped.

This gave us at once a starting point, because it seems evident that if a harmless inorganic reducing agent were added to the solution, carbohydrates should be formed in quantity on exposure to the ultra-violet light. Such a reducing agent is ferrous bicarbonate, and great hopes were raised when it was found that a saturated solution of this compound, which was completely colourless when prepared, gave a copious precipitate of ferric oxide on exposure to ultra-violet light. It was evident that the oxidation took place by reason of the oxygen in the carbohydrate equilibrium in accordance with the equation

$$4Fe\,(HCO_3)_2 + O_2 = 2Fe_2O_3 + 4H_2O + 8CO_2,$$

and indeed it was found that on evaporation of the exposed solution a simple sugar was obtained. The quantity produced was very disappointing and far less than was anticipated, and the conclusion was forced upon us that some unknown factor was taking part in the process.

During many unsuccessful endeavours to improve the yield of the carbohydrates, it was noticed that the ferric oxide was not produced in the body of the solution, but only on the walls of the quartz containing vessels and on the surface of the iron rods used to make the bicarbonate. This led us to suspect that the surface was a determining factor, and we at once changed the experimental method so as to increase the surface as much as possible. In order to secure this a suspension of pure aluminium powder in water, maintained by a stream of carbon dioxide, was exposed to ultra-violet light. Increased yields of carbohydrates were at once obtained, but it was also found that the best yields were obtained when the aluminium powder had been allowed to coat itself with hydroxide by remaining in contact with the water before the exposure to light. This latter observation very materially changed our ideas, since it established the fact that the surface phenomenon is of far greater importance than the reducing action, and indeed raised the question as to whether the latter plays any rôle at all in the process.

In order finally to decide this question, an aqueous suspension of pure and freshly prepared aluminium hydroxide, maintained by a stream of carbon dioxide, was exposed to ultra-violet light. There was obtained after filtration and evaporation of the solution a quantity of carbohydrates equal in weight to that produced when aluminium powder was used. This conclusively proved the fundamental significance of the rôle played by the surface, and at the same time the reducing action was found to be entirely unnecessary. Identical results were obtained with other powders, such as aluminium, zinc, and magnesium carbonates.

During the course of these experiments it occurred to one of my students (Dr. W. E. Stephen) that if a green powder were used in place of the white ones the photosynthesis might take place in visible light, the green colour being suggested by the green colour of the plant-pigment chlorophyll. This was found actually to be the case, since a suspension of nickel carbonate maintained by a stream of carbon dioxide in water, on exposure to the light from an ordinary tungsten filament lamp, gave a larger yield of carbohydrates that any of the white powders in ultra-violet light. We soon found that there was no especial virtue in the green colour, and that equally good results were given by pink cobalt carbonate.

Apart from the interest which accrues from the fact that the photosynthesis is thus achieved in a way which shows a real analogy with the natural phenomenon, the method with a coloured surface and visible light has the very material advantage in that the danger of photo-chemical decomposition by ultra-violet light is completely eliminated, with the result that the products are obtained in a purer state.

From the above description of the direct photosynthesis of carbohydrates from carbonic acid in the laboratory, several points arise which require discussion and explanation. In the first place, it may be stated that the most rigid control experiments which we could devise have definitely established the fact that the carbohydrates are not due to the presence of impurities.

One of the greatest difficulties met with in this work was the preparation of the various materials used for the surfaces, since it is absolutely essential that these be completely free from any trace of alkali. It is well known that when metallic hydroxides and carbonates are precipitated they tend to absorb the alkali, and the removal of this is extraordinarily troublesome. The absence of any alkaline reaction in the filtrate after the powder has been boiled with water is no criterion of purity, and the only satisfactory method is to pass carbon dioxide into a suspension of the powder in water for two hours in the dark, and the filtrate after concentration must yield no weighable quantity of alkaline carbonate.

It was frequently found that the carbonates of nickel and cobalt, even when completely freed from alkali, were entirely ineffective in promoting photosynthesis. These can, however, be activated either by heating to 120° or by exposure in thin layers to ultra-violet light, and this fact afforded a very convincing method of carrying out controls. A quantity of one of these inactive powders gives no trace of carbohydrates when exposed to visible light in the manner described. The same sample of powder when activated and used in the same apparatus, with the same water, the same light, and carbon dioxide from the same source, gives a good yield of carbohydrates. So, once and for all, is all doubt removed as to the possible effect of impurities.

For the benefit of those who may wish to repeat these experiments, it may be stated that more recently it has been found possible to prepare nickel carbonate by a new method which is free from the objections characteristic of its precipitation by means of alkali carbonate. A solution of carbonic acid in conductivity water is electro-

lysed, the electrodes being made of nickel plates. The current is taken from a 220-volt circuit, and sufficient resistance is intercalated to reduce the current density to from 1 or 2 amp. per sq. dcm. The electrolyte is cooled by glass coils through which a stream of water is maintained. With electrodes 190 sq. cm. in area it is possible to prepare 30 gm. of pure carbonate in 24 hours. The carbonate should be collected every day by filtration, and it is advisable to clean the electrodes with emery paper every third day.

To sum up the results, so far as they have been described, it has been found possible in the laboratory to produce carbohydrates directly from carbonic acid by a process which is physically similar to that of the living plant. The essential difficulty in our understanding of the natural photosynthesis has been solved, namely, the use of visible light as the agent in a process which the elementary laws of photochemistry taught us to believe could only be achieved by means of ultraviolet light. As so often happens, the explanation when found is very simple. The great amount of energy required to convert the carbonic acid into carbohydrates is supplied to it in two portions, one by the surface and the other by the visible light.

Nothing has been said, so far, of the actual carbohydrates which have been photosynthesised in the laboratory. Although as yet our information is still meagre, there is no doubt that the photosynthetic syrup is a mixture containing glucose or fructose, or both. There are also present more complex carbohydrates, which can be resolved to the simple sugars by the action of dilute acid. The analogy with the products of natural photosynthesis is too close to be passed by without comment.

Although it has not as yet been possible to carry out a complete analysis of this syrup, owing to the difficulty of preparing a sufficiently large amount, interesting information has been gained from the investigation of the sugar syrup obtained by the action of light upon formaldehyde solution. This has been pursued during the last three years. We owe a debt of gratitude to Sir James Irvine for the signal help he has given us in this work. He himself was the first, in association with Dr. Francis, to prove that glucose is one of the substances actually produced. By oxidation of the sugars to the acids by means of bromine, and the crystallisation of the salts of these with brucine, cinchonine, and quinine, we have obtained *d*-erythronic and probably also *d*-gluconic acids. This not only confirms Irvine and Francis in their proof of glucose, but it also proves that fructose is formed just as in the living plant. In addition to that, there is produced a mixture of complex acids which afford convincing evidence of the synthesis of complex carbohydrates.

Although it may be thought that the use of formaldehyde as the starting point takes away something from the interest, yet it must be remembered that it makes but little difference whether in actual fact we start from carbonic acid or formaldehyde. Without doubt the first substance, transiently formed in either case, is the same, namely, activated formaldehyde which polymerises to the sugars.

The similarity between the vital and the laboratory processes is not confined to the fact that the products from the two are the same. Botanists tell us that in the living plant the photosynthesis takes place on a surface; so also is a surface necessary in the laboratory. It has been found possible to compare the quantities of carbohydrates synthesised for equal areas exposed to light in the case of living leaves and the glass vessels of the laboratory. These quantities are about the same. Some plants produce more and others produce less than we are able to synthesise. This similarity may be emphasised, because surely Dame Nature in the living leaf has produced the best machine she could for her purpose of food production for her children of the vegetable kingdom.

There is yet another striking feature which is common to photosynthesis *in vivo* and *in vitro*. The light must not be too strong in either, for if it is too strong, then harmful results at once supervene. This is due to the poisoning of the surface by the oxygen which is set free. In both cases this poisoning slowly rights itself, and in both the synthesis must not proceed at a greater rate than that of the recovery of the surface from its poisoning.

In fine, so far as we have been able to carry the investigations, the processes in the living plant and in the laboratory show most striking resemblance, not only in the compounds which are formed, but also in every feature which is characteristic of them.

For my own part, I would go further than this, because I believe that these experimental results help us to gain some understanding of the chemistry of life, the chemistry which is so different from that of man's achievements with his test tube, flask, and beaker. Within the confines of vital chemistry, reactions take place which are so far outside our own experimental experience that it came to be believed by many that they were under the control of a mysterious force, to which the name of *vis vitalis* was given. We have considered one of these processes: the condensation of the simple sugars, glucose, and fructose, to form cane sugar, starch, and inulin. No one has yet succeeded in effecting these syntheses in his laboratory, but it would seem that something of that nature takes place in our photosynthesis. Why, then, is it that even this step forward has been gained?

The one lesson that we have gained from photosynthesis is, that the definitive factor is the very large amount of energy which must be supplied to the carbonic acid before the synthesis of the simple sugars takes place. The means of supplying that energy do not concern the argument. The synthesis proceeds at an energy level which is far higher than is the case in the reactions of ordinary chemistry, and the sugars are formed at that high energy level. I myself believe that the condensation reactions to give the more complex carbohydrates are those which are characteristic of the simple sugars when they exist at the high energy

level. The reason why no one has succeeded until now in inducing these reactions to take place is because no one has hitherto been able to supply the large energy increment necessary.

I believe that we find in this the key which unlocks the door of vital chemistry, and that the chemistry of all life is one of high energy, our laboratory experience being confined to the chemistry of low energy. From this viewpoint I see a wondrous vista unfold itself, wherein new understanding, new hopes, and new possibilities reveal themselves. Health and vitality must essentially depend on the high energy level being maintained; any lowering of that level will lead to poor health and weak vitality. Knowledge comes to us of the means whereby the high level may be kept unimpaired. The most important sources from which we can absorb high energy are fresh food and ultra-violet light. From one we learn the necessity of the rapid distribution of our food supply before its high energy is lost; from the other we gain a real understanding of the benefits of ultra-violet light therapy, and, more important still, of the dangers of its misuse. We gain an insight into the chemistry of vitamins, which in the light of our new knowledge reveal themselves as stores of high energy, which yield their energy to restore and maintain the vitality of decadent tissues.

A vision thus comes to us of a new chemistry with limits far flung beyond those which constrain our knowledge of to-day, a chemistry which will embrace and co-ordinate not only the properties of inanimate matter upon this earth, not only the wondrous mechanism of the life of man in health and in disease, but in addition the stupendous marvels of the birth and growth of the worlds outside our own. From those who would decry this as a mere speculation I beg forgiveness, and plead that speculation based on sure experimental fact is the life-blood of true scientific research.

Industry and Research.[1]

By Sir RICHARD THRELFALL, G.B.E., F.R.S.

ONE of the things that strikes a chemist or physicist when approaching the biological sciences is the narrow range of temperature within which alone the phenomena of life occur. A chemist's attention might also be directed to the fact that his medical adviser has to carry a thermometer graduated to fifths of a Fahrenheit degree, with a range of, say, fifteen or ten degrees, in order to investigate the state of health of his patients, whether he practises in Greenland or Ceylon, and only requires one thermometer wherever he is. Human beings can and do exist over a range of, external temperature of more than one hundred Fahrenheit degrees, that is to say, over a range of, say, one hundred times the roughly permissible body temperature variation. How is this possible? It is only possible because man himself has invented means of narrowing the range so as to get within the limits of his own temperature regulation; in other words, he has invented fire, clothing, and housing. Moreover, human beings require food, and they can find it in some form, directly or indirectly, wherever the sun shines on earth and moisture, but not always in a form in which they can assimilate it, so that in effect the supply is limited and competition for it ensues. This has most probably led to human creatures occupying areas where food is available, though climatic conditions are very unfavourable.

It is at least a plausible view that man's struggle with Nature is due to his being driven or tempted to follow the food supply, and by intelligence leading to invention, has devised means of overcoming climatic difficulties, particularly in the supply of heat to his body and its conservation therein. The aspect of the matter which interests us now is the supply of heat by oxidation of carbon and hydrogen in the neighbourhood of the body—not within it—together with the supply of light by which mankind's working life is increased.

Inventions such as the use of fire were made before records were kept, but we have copious records of later inventions, and very likely the earlier ones came about in a fundamentally similar way, as assumed and put forward by Charles Lamb in his "Dissertation upon Roast Pig" First comes the chance observation by an individual gifted enough to seek for its implications; then the endeavour to reproduce the phenomena by copying the original apparatus; then the attempt to distinguish essential from unessential parts of the process leading to a working theory; and finally, the improvement and simplification of the operation under guidance of the theory, which itself is subject to continual extension and improvement. These remarks apply to a fundamental invention, not to productions of improvements which rest on the successive observations and thought of many individuals. I cannot think of any discovery made in my time that does not rest to a greater or less extent on previous work.

Both academic and technical progress has been made throughout the ages, and indeed until within the last twenty years or so, by the efforts of individuals who were usually engaged in, and were paid for, quite other matters than the making of discoveries. Indeed, I remember the time—not so very long ago—when research was looked upon by the majority of quite educated people as a sort of hobby to be indulged in by those whose means permitted them sufficient leisure. So far as I know, the Royal Institution was one of the first places where physical and chemical research was looked upon as the primary duty of the professor, though, of course, the endowment of learning, that is, the careful investigation of what much earlier people had written or said, is a very old idea.

[1] From an address delivered on the occasion of the [illegible] of the new research laboratories of the Gas Light and Coke Co., [illegible]ulham, London, on July 26.

Looking back over the history of civilisation, it seems amazing that so much thought and time should have been spent over the study of the opinions of people whose sources of information were so meagre however acute their intellects may have been, while the whole vast subject of the study of the phenomena of the habitable world was left severely alone. No doubt an explanation can be thought of, but the history serves as a warning of how difficult it is to overthrow a false standard of intellectual activity after it has once become established, and particularly after it has attained the dignity of being a 'vested interest.'

Let us turn to the history of our own art, that of carbonising coal. Passing over previous limited attempts, I direct attention to the fact that Boulton and Watt's factory near Birmingham was illuminated by gas—presumably as a demonstration—by Murdoch at the celebration for the Peace of Amiens in 1802. In Thorpe's "Dictionary of Applied Chemistry," 117 years later, Dr. Harold G. Colman, a recognised authority, writes as follows: "Up to within the last few years the method of manufacture of coal gas has remained in its general principles almost identical with that employed by Murdoch and his immediate successors (prominent among the latter being Samuel Clegg, senior, and his son, Samuel Clegg, junior), although in detail and in the magnitude of the operations great change has taken place."

Whatever the reason may be, the fact remains that during the prosperous days of the nineteenth century the gas industry, like many others, did not devote much time or money to 'work for the future,' the term by which a chairman of the old Edison Co. in U.S.A. denoted research. Meanwhile—I need not repeat the well-worn tale—Germany had fought its way into competing with England's foreign trade by proceeding in what they would call a 'rational' manner, alike financially, commercially, and technically, and especially by 'working for the future' they improved the present in all directions. During the War, this process, long appreciated by the few, penetrated even into political circles, and there was some searching of heart as to why industry in Great Britain had not also 'worked for the future.' In view of the fact that several millions a day were being spent on the War, those in authority decided that some moderate sum might be spent in an endeavour to put the position of research in scientific, and particularly technical, matters on a better basis. After a time, during which the ground was surveyed, the policy settled down to creating institutions devoted to the study of matters supposed to be beyond the scope of individual effort, and encouraging the members of various industries to combine for research purposes, a sum of one million pounds being devoted to the assistance of the latter. The new venture, born in the Education Department, was placed under the Lord President of the Council for administrative purposes, with Sir William McCormick as executive chairman and Sir Frank Heath as secretary, and an advisory council of scientific men and industrialists.

As one who has had a continuous but small part in its development, I may say that, subject to the strict but sympathetic attitude of the Treasury, its own frugality, and the interest shown in it by successive Lord Presidents, whatsoever success the Department may have attained has been mainly due to the wisdom and work of the chairman and secretary.

The activities of the Department of Scientific and Industrial Research are, of course, adequately described in the annual reports, but there are one or two points to which I might refer. In the first place, the guiding principle has always been rather to induce the industries to do things for themselves than to attempt to do scientific work for them. The idea was that if only those who conduct manufacturing operations could be brought to value doing work for the future by investigation, they would willingly continue such work without external pressure. The difficulty would lie in creating initially a receptive state of mind, a difficulty so great that it could only be overcome by actual demonstration. From this it was hoped there would arise in time such a body of enlightened opinion that nobody would dream of conducting a manufacture without the assistance of systematic research. There is scarcely any industrial operation, perhaps no such operation at all, which would not benefit if it were systematically investigated. For example, to take the gas industry, which has been in existence now for something like a century and a quarter, one of the surprises of my life was to find that it was the opinion of the leaders of the technical side of the industry that research was required into the working of ordinary horizontal gas retorts, and I noticed some two years ago that the chairman of Imperial Chemical Industries stated in his annual address that research was still needed in relation to the ammonia-soda process.

Another matter which was forced upon the Department's attention at a very early date was the difficulty of finding properly equipped young men to carry on the investigations it was proposed to set going. It always used to be said that the rapid progress made in the dye industry in Germany was largely due to the fact that their system of education produced many more young men capable of scientific employment than were available in England. Very likely there is some truth in this. At all events, when the Department began to seek for workers, it was faced with a very great difficulty in finding them. Accordingly, and with the consent of the Board of Education, a system was instituted by which promising young graduates were assisted to continue their training for two or three years, during which time they underwent a sort of apprenticeship in research work under their own teachers. Great care was exercised both in the selection of the candidates and in watching their careers, as much as £50,000 a year being spent on this activity at one time. The results, I may say, have on the whole been entirely satisfactory, but I have always felt that the pursuit of science, either pure or applied, could not become a reason-

able profession until a sufficient number of reasonably good openings was assured.

In the course of my life, particularly as a fisherman, I have noticed what great observational powers are possessed by many people who would not describe themselves as in the least scientific, and I have gradually come to the conclusion that there is plenty of raw material among the young men and women of Great Britain, which only needs reasonable encouragement to form the personnel of a large research army. In short, parents must be assured that science as a profession is worth following from the financial point of view before their sons and daughters will be allowed to embrace a scientific career.

In establishing new laboratories there are two things to be considered—equipment and personnel. Of these, incomparably the more important is personnel, for the best equipment differs from the worst only in saving time for those who are using it. During recent visits to America I have taken the opportunity of conferring with the heads of many large industrial laboratories in that country, with the view of ascertaining the lines on which such laboratories are best conducted. I may say that I had very decided views of my own on the subject after spending something over half a century as a laboratory worker, and I was pleased to find that these views were entirely corroborated. In a word, it amounts to this, that everything turns on the personality of those at the head of the laboratory; that is to say, it depends on qualities with which the chief was endowed by Nature and not upon the knowledge he may have acquired. Of these qualities, enthusiasm for the work is the most important. Service should be looked at before remuneration. There should be personal contact between the director and the worker, and I personally, if forced to choose, would select an enthusiastic director rather than a distinguised exponent of the science he professes.

I have heard a good deal about team work of late years, but I have never understood exactly in detail what this term is held to mean. Of course, a large number of people may be employed to study different aspects of any particular phenomenon. Does team work mean that they are to exchange their ideas freely?—if so, it can do nothing but good. On the other hand, does it mean that workers are expected to conceal their identity in the presentation of results?—if so, I think that one great incentive to every worker is withdrawn. I propose as a more effective alternative to the elimination of the man whose attitude is, "I said it first," that all workers should make it a point of honour, and I speak to senior workers more particularly, to make a habit of giving, if anything, more credit rather than less to those who work under or with them, for any advance that may be made by their conjoint efforts.

Obituary.

PROF. S. S. NEUSTRUEV.

IN the sudden and unexpected death of Prof. S. S. Neustruev, of the University of Leningrad, on May 24, whilst on an expedition to Kirgizia, soil science has suffered another severe loss. Neustruev, like Glinka, who predeceased him by only a few months, was one of the greatest representatives of the school of Dokuchaiev, a school which is responsible for most of the modern views on soil genesis and classification.

Neustruev was born in Murom in 1874, and graduated in the physico-mathematical department of the University of Moscow in 1898. He was then appointed to the staff of the soil department of the Zemstvo in Samara, where he worked until 1906, and whilst there he published several papers dealing with the soils of Samara, particularly from the geological point of view.

During 1906 and 1907, Neustruev was investigating questions of soil structure, and from 1908 to 1914 he was a member of the botanical and soil expeditions sent by the Emigration Department and the Dokuchaiev Committee to Turkestan. His time spent in Turkestan was very fruitful, and he published numerous monographs and articles. For his first report he received an award from the Royal Geographical Society.

From 1915 to 1918, Neustruev was the leader of the Orenburg soil expedition of the Dokuchaiev Committee, and then for some time worked in western Siberia. In 1922 he became secretary of the Dokuchaiev Soil Committee and editor of its *Bulletin*. Under his supervision classes in geography were started, which later developed into the geographical faculty of the University of Leningrad. In recent years he led two important expeditions for the Academy of Sciences to Kasakstan and Bashkiria. In 1924–25 he took part in a detailed soil geological survey of the neighbourhood of Leningrad, and in 1924 he also conducted investigations in the northern Caucasus.

Neustruev was one of the Russian delegates to the International Congress of Soil Science in Washington in 1927, and those who took part in the excursion across America will never forget his unfailing courtesy and the painstaking care with which he explained the Russian views on the field study of soils. At this Congress he was chosen to edit the International Soil Map of Asia.

In April 1928 he was elected chairman of the Leningrad organising committee and vice-president of the general committee for the second International Soil Congress which is to be held in Russia in 1930, and of which he was to be chairman of the committee on the genesis and classification of soils.

Neustruev was a man of high culture, an accomplished linguist, and altogether a most attractive personality. He has left a scientific legacy of about 100 publications. Many of these deal particularly with south-eastern Russia and Turkestan, but he has also left a number of papers of more general interest, such as his essay on the "Classification of the Processes of Soil Formation."

...of S... ...of the Washington 1927).

Probably Neust... ...authority on the soils of deserts and the dry southern steppes, and the great group of grey soils known as Serozyoms (literally raw earths) were named by him. As soil scientist, geologist, and geographer he was an outstanding figure, and his kindly presence will be greatly missed at the next international meeting, for the success of which he had been working so hard.

W. G. OGG.

WE regret to announce the following deaths:

Dr. R. E. Allardice, emeritus professor of mathematics at Stanford University and formerly of the Department of Mathematics of the University of Edinburgh, on May 6, aged sixty-six.

Prof. Gunnar Andersson, professor of economic geography in the Commercial High School, Stockholm, and author of numerous works on plant geography and related subjects, on Aug. 5, aged sixty-three years.

Prof. F. S. Carey, formerly professor of mathematics in the University of Liverpool, on July 26, at sixty-eight years of age.

Mr. D. C. Davies, director of the Field Museum of Natural History, Chicago, since 1921, aged sixty-two years.

Dr. William Dyson, emeritus professor of medicine, University of Sheffield, on July 9, aged seventy-eight years.

Prof. William Esty, head of the electrical engineering department at Lehigh University, known for his work on dynamo machinery and the resistance of insulating materials, on July 7, aged fifty-nine years.

Prof. Jinzo Matsumura, for nearly thirty years director of the Botanic Gardens, Koishikawa, and professor of botany in the Imperial University, Tokyo, on May 4, aged seventy-three years.

Mr. S. B. Parish, honorary curator in the herbarium of the University of California and an authority on the flora of southern California, on June 5, aged ninety years.

Dr. Charles Platt, emeritus professor of biological chemistry in the Hahnemann Medical College, Philadelphia, aged fifty-nine years.

News and Views.

IN January last, a conference was appointed to examine the situation which had arisen out of the competition between the beam radio telegraphic services and the submarine cable companies. Representatives of all the interests concerned gave evidence before the conference. In England the beam radio stations are owned and worked by the Government, whilst in the dominions they are operated by private companies. Except in the case of the beam radio service to Canada, where the rates are the same as by cable, the radio service is cheaper than that given by the cable companies. After discussing five possible ways in which the situation might be dealt with, the conference has unanimously recommended the formation of a 'communications' company, to which the cable and radio companies concerned could sell all their communication assets for shares. This company will also acquire the Government cables and the lease of the Post Office beam services. The latter will be for 25 years at a rental of £250,000 per annum. The recommendations of the conference have been accepted by Parliament. This we regard as satisfactory, as experience has shown that the development of a new method of communication, the technique of which is still almost in its infancy, requires initiative which government departments rarely show. Sufficient safeguards are made to prevent the system becoming a monopoly. A standard net revenue has been fixed, and half of all the net revenue in excess of this either goes to cheapening the rates or to such other purpose as the advisory committee may approve. In the future the communications company will be a great imperial utility corporation, managed privately, but under rigorous public control.

WISE words of caution are addressed to those enthusiastic game preservers who would destroy root and branch any creature regarded as a pest, by the "Committee on Species destructive to Game," appointed by the National Game Conference of the United States. The Committee, the report of which appears in *California Fish and Game* (April 1928, p. 134), found it impossible and undesirable to draw up a list of species which should be classed as destructive or to recommend definite measures of destruction, because conditions and circumstances varied so widely, that a species harmful in one area might be perfectly innocuous in another. It is stated that "in the absence of basic knowledge, prejudice has had full sway and has led unthinking people to commit deeds harmful and, when carried to extreme, disastrous to game conservation." In the control of animals that are truly game destroyers, locality must be first considered, and "the matter of control of enemies of game must be looked at from every angle by game breeders and sportsmen, since other important agencies enter into the problem." Where conflict of interests occurs, as may happen between agriculture and game conservation, it is recommended that only the individuals actually attacking game should be killed; the Committee is definitely against the system of paying bounties, and stands by local control under proper legal supervision."

ON Aug. 1 the East Africa Archæological Expedition left England for Africa. Its object is to continue the investigations in the Elmenteita-Nakuru area of Kenya Colony, where, in 1926–27, Mr. L. S. B. Leakey made his remarkable discoveries bearing upon the antiquity and distribution of early man in Africa. These are reviewed by Mr. Leakey in an article contributed to the *Times* on the day the expedition sailed, in which he points out that while it is at present impossible to relate the Pluvial Periods of Equatorial Africa to the Glacial Epochs of Europe, they are at least pleistocene. Further, that of the skulls from Elmenteita which are held to resemble the Combe Capelle skull of Lower Aurignacian age ...

bears a close resemblance to the Oldoway skull discovered in Tanganyika in 1913, where of the associated fossils at least 50 per cent are pleistocene. Mr. Leakey now makes the interesting suggestion that the Elmenteita culture represents a south-eastward extension of the Capsian culture from the Sudan at the beginning of the last Pluvial period, while the fragmentary human remains from the earlier periods may turn out to be the earliest examples of *homo sapiens* as yet known. Mr. Leakey refers to other problems calling for investigation which need not be enumerated here; but it will be seen that the expedition has the prospect of much useful and valuable work before it. The limit, indeed, seems to be set only by the amount of the funds available, admittedly at present very far from adequate. The expenses of this year's expedition are being met with the assistance of the Royal Society and the Percy Sladen Trustees.

A MEETING of the Astronomische Gesellschaft was held at Heidelberg on July 18–21. Coming so soon after the meeting of the International Astronomical Union at Leyden, a large number of British and American astronomers were able to attend. The important question of the re-observation of the A.G. Catalogue by photography was fully discussed, and a number of interesting communications on various subjects were read. Dr. Max Wolf invited the members to tea at the Königstuhl, and they were shown round this beautiful observatory. The members were welcomed by the State university and municipality, and were entertained at a dinner at the Molkentur, at which the Rector of the University, the president of the Astronomische Gesellschaft, the Astronomer Royal, Prof. Schlesinger, and M. Mascart spoke. An invitation by the municipality of Stuttgart included a visit to Weil der Stadt, where Kepler was born. A wreath was placed on his statue by Dr. Max Wolf, and short addresses were given by Dr. Wolf and Prof. Eddington. At Stuttgart a demonstration was given of the Planetarium. The meeting terminated with a visit to Mannheim, by kind invitation of the municipality. On the journey to or from Heidelberg many of the members, by kind invitation of Prof. Kohlschütter, visited the observatory of Bonn and saw the instruments and observatory of Argelander.

A CORRESPONDENT in Southern India has forwarded an account from an Indian newspaper of phenomena observed in a village in Central Travancore early in June of this year, which indicates that a tornado visited that village. The account describes the passage of a "cylindrical column of water 20 to 30 feet high" across a paddy-field, the column "emitting fire and making a dreadful noise," and the ground is said to have been torn up so as to leave a deep well-like hole. It is presumed that the "column of water" was in reality a column of cloud (the 'funnel' cloud of the tornado), that the fire was the lightning which so often accompanies such a cloud, and that the noise was caused by the extreme violence of the wind, and perhaps also to some extent by the thunder. It is known that tornadoes occur occasionally over most of the temperate and tropical parts of the world, their true 'home' being the U.S.A. east of the Rockies. The climate of India as a whole, except during the rainy season, is normally too dry to favour this occurrence.

ON July 31 the Rt. Hon. the Earl of Balfour, as president of the Committee of the Privy Council for Scientific and Industrial Research, held an informal reception at the Forest Products Research Laboratory recently erected at Princes Risborough, Buckinghamshire, for the Department of Scientific and Industrial Research. The object of the reception was to bring to the notice of all interested the facilities existing in the new laboratories for scientific and technical investigations aiming at the conservation and efficient use of the timber supplies of Great Britain, both home-grown and imported, and to enable visitors to see the important work already in progress. About 140 guests attended, representative mainly of timber merchants and users. Representatives of Dominion Governments were also present.

THE Forest Products Research Laboratory, which was completed and equipped during the past year, is now fully in operation. It comprises sections for the study of timber seasoning, timber mechanics, timber physics, wood technology, entomology, wood preservation, wood-working, and timber utilisation. Investigations on behalf of the Laboratory are also carried out at the Imperial Forestry Institute, Oxford (wood technology and chemistry), the University of St. Andrews (chemistry), and the Imperial College of Science and Technology, South Kensington (mycology). The work of the Laboratory is under the immediate direction of Mr. R. S. Pearson, director of Forest Products Research, and the general programme of work is supervised by the Forest Products Research Board, under the chairmanship of Sir James C. Irvine, vice-chancellor and principal of the University of St. Andrews.

AT the request of the governors of the Royal Veterinary College, Camden Town, the Minister of Agriculture and Fisheries has appointed a Departmental Committee, under the chairmanship of Sir Charles Martin, director of the Lister Institute, "to consider and report generally on the reconstruction of the Royal Veterinary College and the probable cost; and in particular on the questions what accommodation should be provided, having regard to the training to be given; whether that accommodation can and should be provided on the present site; if not, where the College should be transferred; and what arrangements should be made in respect of the Animal Pathology Research Institute now situated at the College, if it appears necessary to change the existing arrangements."

A MEMORIAL to Thomas Telford, the famous roadmaker and engineer, erected in his native parish of Westerkirk, Dumfriesshire, was unveiled on Aug. 3 by the Duke of Buccleuch. Telford was born in 1757, and his constructive works included the suspension bridges over the River Conway and the Menai Strait, the Caledonian and Ellesmere canals, and nearly one thousand miles of main road, with more than twelve hundred bridges, in Scotland.

AN enthusiastic group of naturalists a few years ago combined to issue the *Journal of the East Africa and Uganda Natural History Society*, No. 30 of which has just reached us. In view of the changes which inevitably follow upon the spread of civilisation, the recording of native faunas while aboriginal conditions still exist, becomes a matter of historical importance, and this Society is to be congratulated upon the thoroughness with which it is accomplishing its task. The present number continues Dr. von Someren's well-illustrated accounts of the butterflies and the birds of Kenya and Uganda, in which life-histories and habits receive as much attention as systematic description. An article on fishing in the Kavirondo Gulf, Lake Victoria, by C. M. Dodds, has interest for the naturalist, and ought to be invaluable to the ethnographer interested in the peculiar apparatus of traps, nets, hooked lines, and fishing spears employed by the natives in carrying out a fairly extensive fishery. Already civilisation is telling upon the native ways, for it is stated that in 1921, when the industry was more flourishing than it is to-day, up to 20,000 nets were imported from Ireland.

THE increasing attention which is being paid to the grazing possibilities and the mineral wealth of Canada's Arctic territories, is illustrated by a special number of the *Canadian Naturalist* (March 1928), which is entirely devoted to an article by Mr. E. M. Kindle on "Canada North of Fifty-Six Degrees." This includes the northern part of the great provinces, and the whole of Yukon and the North-West territories, much of which are known by the misnomer of the 'barren lands.' The numerous illustrations in the article are particularly striking. It is also announced that investigations into the value of those northern lands for reindeer are continuing. Messrs. A. E. and P. T. Porsild, who have been engaged on the work since 1926, have reported favourably on the region east of the Mackenzie delta. The annual patrol ship of the Canadian Arctic islands has left Sydney, Nova Scotia, for the north. Various researches will be carried out during the cruise.

"AGRICULTURAL Research in 1926" is the second of a series of annual publications issued by the Royal Agricultural Society for a twofold purpose; first, to record the results of research work, not necessarily from Britain only, in a concise form suitable to the practical farmer, the county organiser, and those engaged in the education of agricultural students; secondly, to prevent the loss to sight of valuable work owing to diffusion in publication. Definitely negative results are also included because of their importance from the practical point of view. The success of the first volume shows that such a type of publication is appreciated. The present number consists of seven reports, written by well-known research workers on such widely different subjects as crops and plant breeding, dairy husbandry, agricultural economics, agricultural engineering, animal nutrition, soils and fertilisers, and veterinary science. It is impossible in a few words to indicate the scope of the publication, but as an example of investigations on subjects which closely touch the daily life of the community, the production of Grade "A" (tuberculin tested) milk, the factors affecting the amount of fat in cow's milk, and taints and flavours in milk and dairy produce are among the questions discussed under dairy husbandry, while an account is given in the report on veterinary science of the progress of the work on foot-and-mouth disease. Although no method of cultivating the virus outside the body has yet been discovered, much important work has been done with regard to its survival in carcases subjected to various treatments. Ample references are appended under each report, so that further information may be obtained if desired; the publication will serve as a useful source of reference to research workers.

THE third annual meeting of the eastern section of the Seismological Society of America was held on April 30–May 2, in the University of Virginia at Charlottesville. At different meetings, papers were read on general seismology, practical and experimental seismometry, and the earthquakes of the United States. As regards the instruments to be used, the Wood-Anderson torsion-seismometer has established its place as the best instrument for recording near earthquakes or those with origins not more than 1500 miles distant. For teleseisms, the Wenner seismograph has proved its value, especially for measuring the azimuth of a distant epicentre. The earthquakes of the United States were considered in several papers. Dr. F. L. Hoffman concludes that the earthquake hazard to the Panama Canal is apparently of no serious importance. Prof. S. Taber shows that, in the Atlantic states, earthquakes are scattered and do not recur along faults as on the Pacific coast, but that in shocks of the same intensity the former disturb areas from 5 to 25 times as great as the latter.

THE sixth Annual Report of the Safety in Mines Research Board, recently issued (London: H.M.S.O. 9*d*. net), records the work of that organisation during 1927. The extensive character of the work can be inferred from the expenditure, which exceeded £52,000, mainly derived from the Miners' Welfare Fund. Some of the work is carried out under the direct supervision of the Board, and other problems are examined with its support at universities and other institutions. Among the subjects of study are explosions of gas and coal dust, the spontaneous ignition of coal, mechanical and electrical engineering problems, rescue apparatus, safety lamps, and investigations of a medical and physiological character. These are under the oversight of the Health Advisory Committee and are typified by work on nystagmus and the injurious effects of certain rock dusts. During the year eleven reports were issued, and numerous publications have been made through other channels. Two features which attract attention are the intention to issue popularised accounts of the work or the benefit of operative mine workers and the organised collaboration between the Board and the U.S. Bureau of Mines.

DR. J. MACMILLAN BROWN points out an error into which the reviewer of his book in NATURE, April 28,

p. 665, has inadvertently fallen. In "Peoples and Problems of the Pacific" (vol. 1, pp. 187, 188), Dr. J. Macmillan Brown gives what may be regarded as authoritative evidence of the submergence of an island called Tuanaki, which was "asserted to be situated not more than 200 miles to the south or south-west of Rarotonga," or, "according to most reports, it lay to the south-east of Rarotonga, between that island and Mangaia." William T. Brigham says in his "Index to the Islands of the Pacific Ocean" (p. 159, 1900): "*Tuanaki*, or Reid, atoll in the Raeffsky group, in the north, uninhabited, 16° 41′ S., 144° 14′ W."; "*Tuinaka*, or Reid, of the Paumotu archipelago. North-west point is in 16° 37′ 17″ S., 144° 13′ W." Dr. Macmillan Brown informs us that "the two are evidently the same island, as I can testify having passed it in my voyagings through the Paumotus, and the proper name is 'Tuinaka'; it is still uninhabited, like nearly half of the Paumotus." Evidently Dr. W. T. Brigham, "as a rule the most trustworthy of authorities," has been misled in this matter, as was also the reviewer, who followed him.

The report of the New York Aquarium for 1927 marks the close of a quarter of a century since the administration of the Aquarium was taken over by the New York Zoological Society and since Dr. C. H. Townsend was appointed director. The report, written in the director's absence on the Galapagos Expedition, by Charles M. Breder, contains strong remarks about the "pernicious difficulty" of working "on extremely meagre amounts of money, resulting in an unfortunate but necessary attitude towards disbursements," but notwithstanding it shows that very great progress has been made during these twenty-five years in adapting the aquarium to meet modern conditions. In particular, the improvement of the building itself seems to have been appreciated by the public, for a considerable increase is shown in the annual attendance, which reached a total of 2,129,305, or 5834 individuals a day. There is no detailed statement of the cost of running the Aquarium, but it would appear from a short note that the receipts from the City of New York and from the New York Zoological Society amount to about £15,000.

The scientific work accomplished by the Smithsonian Institution, and described in its twelve series of publications, is well known and appreciated by all scientific workers, but the extent of the Institution's efforts to interest the public of the United States in its activities is less well known, and is an object-lesson which scientific institutions in other countries cannot afford to ignore. One of its two annual publications devoted to the enlightenment of the people contains simple accounts of the *Explorations and Field-work of the Smithsonian Institution*. The volume for 1927 contains 188 pages, at least half of which are filled with reproductions of photographs. It describes thirty various explorations launched by the Institution for objects which range from anthropological studies of early man in Europe, and of living American Indians and Eskimo, to archæological excursions in China, geological trips in the States, zoological and botanical journeys to South America, Siam, Sumatra, and elsewhere. The extent and number of the explorations suggest almost unlimited financial resources, but the preface specifically states that the Institution has almost no unrestricted funds for field-work. Practically all the expeditions sent out each year are made possible either through the help of generous friends and patrons, or through co-operative arrangements with other scientific agencies whereby costs and collections are shared. British institutions have yet much to learn in this method of adding to scientific knowledge.

The latest catalogue (No. 309) of second-hand scientific books and serials offered for sale by W. Heffer and Sons, Ltd., 4 Petty Cury, Cambridge, includes among its 1800 items a selection of works from the library of the late Sir Arthur E. Shipley, books used by the late Sir Harry H. Johnston, and a number of duplicates from the Balfour Library, Cambridge. Readers interested in almost any branch of science should obtain a copy.

The Kaiser-Wilhelm-Institut für Silikatforschung in Berlin-Dahlem, founded in 1926, under the direction of Dr. W. Eitel, has recently issued a volume containing twenty papers, previously published elsewhere, dealing with the work of the institute. Most of the papers are concerned with the crystal structure of various minerals and organic compounds, but some are of more general interest. The volume should prove to be equally interesting to both chemists and geologists.

The Section of Geodesy of the International Union for Geodesy and Geophysics has recently issued, as Tome 4 of its *Publications*, a collection of the general reports presented at the second assembly of the Union at Madrid in 1924. The subjects dealt with at length are precision levelling (by Lallemand), determinations of latitude, azimuth, and longitude (by Jolly), isostasy (Bowie), and projections and computations (Roussilhe). There are also short reports on the deflection of the vertical (de Graaff Hunter), the intensity of gravity (Soler), earth tides (Lambert), and the stability of the earth's angular velocity (E. W. Brown).

Applications are invited for the following appointments, on or before the dates mentioned: An inspector under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Acts, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall-place, S.W.1 (Aug. 20). A junior engineering assistant in the water department of the County Borough of Wolverhampton—The Town Clerk, Town Hall, Wolverhampton (Aug. 20). A working instructor in automobile engineering in Loughborough College Works Departments—The Registrar, Loughborough College, Leicestershire (Aug. 21). A woman lecturer and organiser in hygiene and infant welfare work under the Somerset County Council—W. G. Savage, County Health Department, Boulevard, Weston-super-Mare (Aug. 23). An agricultural analyst for the county of Dorset—The Clerk of the County Council, County Offices, Dorchester (Aug. 25). A lecturer in scientific German at the Northern Polytechnic, Holloway—The Clerk, Northern Polytechnic, Holloway, N.7 (Aug. 29). A professor

of mathematics in the University of Melbourne—The Agent-general for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (Sept. 3). A full-time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 7). Keepers of, respectively, the departments of botany and vertebrate zoology of the Museums, Liverpool—The Director, Free Public Museums, William Brown Street, Liverpool (Sept. 10). A lecturer in organic chemistry in the department of organic and applied chemistry of the Sir John Cass Technical Institute—The Principal, Sir John Cass Technical Institute, Jewry Street, E.C.3 (Sept. 12). A senior member of the staff of the British Launderers' Research Association, for carrying out technical investigations connected with the laundry industry—The Director of Research, British Launderers' Research Association, Hill View Gardens, Hendon, N.W.4. A laboratory assistant at the Royal Gunpowder Factory—The Superintendent, Royal Gunpowder Factory, Waltham Abbey, Essex. An assistant lecturer in the department of biology of the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield. A full-time teacher of subjects in mining courses at the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley. The Gardiner professorship of physiological chemistry in the University of Glasgow—The Secretary of the University Court, University, Glasgow. An evening teacher of machine design and machine drawing at Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14. A teacher of practical mathematics at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon.

Our Astronomical Column.

THE DEGREE OF ACCURACY OF METEOR OBSERVATIONS.—Mr. A. King contributes a paper on this subject to *Mon. Not. Roy. Ast. Soc.* for May. He considers (1) observations by experts in this work, (2) those by people who know the stars, but are unpractised in meteor work, (3) those by quite unskilled observers. Twenty-four meteors in class (1) show very satisfactory accordance; the heights at commencement of path range from 93 to 45 miles, those at end from 80 to 25 miles; the velocities are in close accord with those calculated on the parabolic assumption, allowance being made for the earth's attraction. From the comparison of the results of different computers, the probable errors of heights and radiants are within a fraction of a mile and a degree respectively.

The results in class (2) are considerably less precise. The uncertainty of the radiant is now 3° or 4°. Class (3) is of value only when a very large number of observations is available; the errors then tend to cancel out. As an example, nearly 300 observations were available of the Yorkshire fireball of Sept. 6, 1926. Mr. Denning and Mr. King differed only by 2° in the radiant. Prof. Shapley has lately urged more careful study of meteors, hoping that the study may lead to important results in stellar physics.

ε AURIGÆ.—Mr. P. Doig contributes a note on this interesting variable star to *B.A.A. Journal*, No. 7. It is of special type *F*5, and Miss C. Payne has deduced from the spectrum the absolute magnitude − 4·0. Its normal apparent magnitude is 3·3; it drops to 4·0 at minimum; the period during which the light is below normal is 700 days, for 300 of which the light is constant at its minimum value; the interval between minima is more than 27 years—the longest period known. Miss Payne's value of the absolute magnitude gives a distance of nearly 1000 light-years; from the statistics of giant stars, Mr. Doig estimates a diameter 50 times that of the sun and a mass 35 times that of the sun. The variation of light has usually been ascribed to eclipse; on this assumption Prof. Shapley found that the radius of the primary is 0·03 of the major axis of the relative orbit. The estimated diameter given above makes the semi-major axis of the orbit 4 astronomical units. This with a period of 27 years gives a mass 1/11 of that of the sun; according to Eddington, this is less than the minimum possible mass for a star (which is about 1/7 of the sun's mass); it is in any case incompatible with an absolute magnitude − 4. These considerations throw grave doubt on the hypothesis that the variation is due to eclipse. At the moment no other plausible explanation suggests itself.

LICK OBSERVATORY CATALOGUE OF RADIAL VELOCITIES.—The observation of radial velocities has been one of the chief branches of work at the Lick Observatory. Volume 16 of the *Publications* of the observatory contains the results in the form of a catalogue of the radial velocities of 2400 stars. Those south of declination − 20° were observed by the D. O. Mills expeditions to Santiago, Chile, which began in 1903 and went on for the remainder of the period covered by the catalogue, which extends from 1896 to the end of 1926. The larger part of the volume contains the separate daily results for each star, together with notes on peculiarities of spectrum and on the lines employed: the catalogue proper only occupies a few pages at the end.

Variable velocity is established for 351 stars in the catalogue, and is suspected for 81 more. The variation is clearly shown in the case of Procyon; the observations of this are combined in groups; the extreme values are − 4·28 km./sec. for the period 1903–6, and − 1·60 km./sec. for the period 1918–23. The centre of mass of the first component of Castor has the value − 1·2 km./sec., that of the second component + 6·0 km./sec. Polaris has been observed more than five hundred times; the details are not given, but it is noted that the period of the short variation is 3·96809 days, the longer period being probably greater than thirty years. There are numerous observations of both components of α Centauri. The radial velocity of the system is given as − 22·2 km./sec. The radial velocity of Arcturus is unexpectedly small, considering the star's large proper motion. The mean of 56 determinations is − 5·35 km./sec. The catalogue is practically complete down to magnitude 5·5, there being only 69 stars absent. Most of these have been observed elsewhere; some are difficult to measure.

The introduction contains much interesting matter; for example, the endeavour to make a hole in the middle of the original 36½-inch mirror, which resulted in the mirror flying to pieces under internal strains. Fortunately, a better mirror was obtained from the St. Gobain Co.

Research Items

THE INTER-SEX PIG IN MELANESIA.—In *Man* for July, Mr. J. H. Baker describes customs in which the inter-sex pig plays a part in the New Hebrides. Inter-sex mammals are particularly abundant in this area. Among them the pig exhibits a complete range of variation in the external parts from the female anatomy to a fairly complete approach to the male. Internally, only male organs occur. The inter-sex has an important social significance. They are highly valued, being worth half as much again as the male. Their chief use lies in their function in the pig-killing feasts, by which a man rises in the five ranks of precedence. A certain number of male and inter-sex pigs must be killed at each step. As the native does not breed pigs systematically and on a large scale, it is necessary that he should borrow on these occasions. But anyone who is unpopular will not be able to obtain a loan. One method of obtaining pigs is by extorting payments of pigs to avert ill caused by the magic powers of the extortioner. He may threaten the owner with injury to health, or even with death. It comes about, then, that only popular men or those feared for their magic powers are able to obtain the pigs necessary to rise in rank. The promotion takes place at a ceremony which includes a night-long dance. The pigs are killed at this ceremony, but not eaten. Indeed, the inter-sex is never eaten except by women and children. Loans of pigs, which are the standard currency, involve a complicated system of interest, as a loan has to be repaid with a pig of the size which the loan pig would have attained in the interval had it been allowed to live.

OSIRIS AND THE TREE AND PILLAR-CULT.—In *Ancient Egypt* for June, Sir Flinders Petrie discusses the relation of the Osiris legend and the pillar cult—a question bearing upon the suggested connexion between Egyptian civilisation and the Caucasus. The legend that a tamarisk tree grew round and enclosed the body of Osiris and was afterwards cut down by the king and used as the pillar of his house, finds a parallel in two Georgian folk-stories previously recorded in *Ancient Egypt*. Georgia is thus linked with the Osiris legend both by ancient geography and modern folklore. The actual remains consolidate the legend and give it a real basis. The Osiris worshipper must have been as early as the Badarians, for corn was grown and ground by them. As there are no figures of an earlier race except the steatopygous, that was probably the race reclaimed by Osiris from cannibalism, and the practice must have been known to the Badarians from the allusions to it in the Book of the Dead, which refers familiarly to the kingdom of Osiris. The Badarian type of skull being near the Dravidian and early Hindu, there is a presumption that both races originated from some common centre probably in Asia. Putting legends and remains together, the position is that a people living in Georgia possessing agriculture and some civilised arts moved into India and Egypt through Syria, bringing with them myths of the homeland and connected with the principal places between the Black Sea and the Caspian, and possessing a civilisation which decayed in Egypt but uphold the ideals of Osiris and Isis. The worship passed through Syria, Byblos becoming its centre. In Canaan the typical worship was connected with the grove sacred to the goddess and the pillar of wood or stone. The tree (*asherah*) is best explained by the continuance of the worship in which holy trees are thought to be the habitation of a spirit or saint. It may have influenced Christianity and explain the saying of Jesus :

> "Raise the stone and there shalt thou find me,
> Cleave the wood and there am I."

PRESSURE AND PHYSICAL AND MENTAL EFFICIENCY.—Report No. 37 of the Aeronautical Research Institute, Tokyo Imperial University, records an experimental study of the effects of low barometric pressures and oxygen deprivation upon the efficiency of mental and physical work. The research has been very carefully conducted, and control experiments carried out and reported in full. The results seem to show that both physical and mental efficiency are decreased as a consequence of the lowering of the barometric pressure, but from the first group of experiments one cannot determine whether this is due to the decrease of pressure or to the lack of oxygen coincident with the decrease of that pressure. Some further experiments on admittedly too few subjects do seem to indicate that the decrease in efficiency is due to the lack of oxygen rather than to the low pressure in itself.

A NEW LETHAL FACTOR IN CATTLE.—A striking case of a recessive lethal factor in Swedish Holstein-Friesian cattle has been described by Mohr and Wriedt (*Jour. of Genetics*, vol. 19, No. 3). Matings of heterozygous bulls to their daughters produce one hairless calf in seven (98 : 12 or 14) according to expectation. The calves have a pink colour owing to the blood-vessels, and the skin is in an embryonic condition except a few areas on the muzzle, eyelids, ears, and legs, which produce hairs. Their teeth and hoofs are normal, but they die a few minutes after birth. The condition was at first supposed to be due to foot-and-mouth disease, but has since been clearly traced to inheritance from one or more heterozygous bulls of high phenotypic quality, who spread it in the herds as a recessive character. Hairlessness is known to occur in man, dogs, horses, rats, mice, goats, and other animals, but is not usually accompanied by lethal defects. Five lethal factors are now known in cattle, and three, or probably four of them, occur in the Holstein-Friesian. This suggests the necessity for using breeding tests to determine whether lethal recessive factors are present in the animals to be used for breeding purposes.

NATURAL HISTORY OF ANGOLA AND RHODESIA.—Fascicule 3 of volume 4 of the Report of the Mission of M. de Rohan-Chabot to Angola and Rhodesia in 1912 1914 (Paris : Paul Geuthner, 1925, 150 francs) has recently come to hand. The expedition was inaugurated under the auspices of the French Ministry of Public Instruction and of the Geographical Society of Paris, and most of its explorations were carried out in Angola, a region rarely visited by French naturalists. The greater part of this finely illustrated publication is occupied by reports by various specialists on the Coleoptera, an order of insects which is shown to exhibit a markedly endemic character in the region concerned. Other reports deal with the Hymenoptera, Arachnida, and non-marine Mollusca and the ferns. In most cases the collections reported upon are relatively small, but they provide a welcome addition to our knowledge of a little-explored region.

INDO-AUSTRALIAN WASPS.—The supplement to vol. 9 of *Treubia* (January 1928) is devoted to a comprehensive monograph of the Scoliid wasps of the Indo-Australian region by Dr. J. G. Betrem, of the Landwirtschaftlichen Hochschule at Wageningen, Holland. This monograph, which occupies nearly four hundred pages, is prefaced by an admirably illustrated account of the general anatomy of these insects and a short dissertation upon their biology. Most of the remainder of the work is devoted to

descriptions of the various species and, in drawing up these, the author has had access to material from many of the great museums of Europe and the Orient. In the concluding chapter there is a general discussion of problems suggested by the geographical distribution of these wasps in the region under consideration. The work is of importance to all entomologists interested in Aculeate Hymenoptera.

IS THE MALARIA PARASITE INTRACELLULAR ?—It is usually stated that the malaria parasites live intracellularly in the red blood corpuscle, but after a series of investigations extending from 1911 to 1920, Dr. Mary R. Lawson concluded (1920) that "all malarial parasites are extracellular, that is, they are attached to the external surface of the infected corpuscle and each parasite destroys several red corpuscles," and this view has been supported by at least two subsequent workers. Herbert L. Ratcliffe (*Amer. Jour. Trop. Med.*, 7; 1927) has carried out investigations on blood taken directly from canaries infected with *Plasmodium præcox* and from man infected with tertian malaria (*P. vivax*), fixed in Bouin's or in Zenker's fluid, dehydrated, embedded and cut into thin serial sections ($1\frac{1}{2}$–2μ thick). In no case was he able to find a parasite extracellular or even deeply embedded in the surface membrane; they are intracellular.

PLANKTON MOVEMENTS.—The *M.B.A. Journal*, N.S., 15, 2, contains an account by F. S. Russell of the vertical distribution of *Calanus* by day from April to September of 1926. There is a diurnal descent from April to June and ascent from July to September. Measurements of the specimens revealed two broods of different sizes, the 'small' brood being dominant from July to September and apparently reacting differently from the 'large' brood, which had tended to avoid the increasing light in the spring.

CONDITIONED RESPONSES IN FISH.—Many of Pavlov's observations on the behaviour of dogs under experiment have been found by H. O. Bull to be reflected in fish (*M.B.A. Journal*, N.S., 15, 2). By association with food he trained *Blennius* to detect a momentary increase of 0·4° C. in the temperature of the surrounding water (and/or the induced convection currents), and a momentary decrease of so little as three parts of salinity per 1000. His wrasses learned to discriminate between different coloured lights or between one or two sources of light, but not readily between differences in intensity of one light. Other experiments using slight electric shocks revealed some colour discrimination in blennies and sensitiveness to a vibratory stimulus in *Crenilabrus* and *Anguilla*. The paper is valuable and important.

MINUTE AMERICAN LAND SNAILS.—Mr. H. Burrington Baker has of late devoted his attention to the anatomy of minute American land snails. His paper on some Mexican forms previously confused with the genus *Thysanophora* (*Proc. Acad. Nat. Sci. Philad.*, vol. 79), has now been followed by one on minute American Zonitidæ (*ibid.*, vol. 80). The author gives a standardised nomenclature as adopted by him for the parts of the genitalia, which if it does not commend itself to other anatomists at least enables those who consult his work to follow his descriptions with understanding. A series of more or less well-known genera and species are dealt with anatomically, some for the first time, and though no new species is put forward, the familiar *Helix minuscula*, Binney, is now made the type of a new genus *Pseudovitrea*.

ORTHOPTERA OF POLAR SIBERIA.—The Yakutsk Commission of the Russian Academy of Sciences has published an interesting list of Orthoptera of the Yakutsk republic by Miss E. F. Miram (*Matériaux de la Commission pour l'étude de la République Iakoute*, part 24; Leningrad, 1928). Materials for the list have been collected by several expeditions of the Academy, and the list includes as many as 35 species, which is a high figure considering that Orthoptera are a group closely connected with warm and dry conditions of existence. Out of these, two species proved to be new to science (*Podismopsis jacuta* Mir. and *Prumna polaris* Mir.). The last named of the two new species is distributed northwards up to the Polar circle, together with *Podisma frigida* Boh. and three species of *Acrydium* (*Tetrix*); there are also four species of *Acrididæ* (*Podismopsia poppiusi* Mir., *Gomphocerus variegatus* F.W., *Podisma koeppeni* Zub., and *Acrydium fuliginosum* Zett.), which extend their area well beyond the Polar circle.

TREE GROWTH AND CLIMATIC CYCLES.—An article recently published as a *News Bulletin* by the Carnegie Institution of Washington, D.C., describes the remarkable correlation existing between annual ring formation in trees and climatic cycles. The work is mainly due to many years of patient effort on the part of Prof. H. E. Douglass, of the University of Arizona, who examined large numbers of yellow pines from the arid region of northern part of the State. The variation in the annual rings of individual trees over considerable areas exhibited such uniformity that the same rings could be identified in nearly every tree, and the dates of their formation established with practical certainty. In dry climates he found that ring thicknesses are proportional to rainfall, with an accuracy determined for recent years of seventy per cent. As this accuracy presumably extends over centuries, the tree records can be expected to give indications of climatic cycles and of past climatic conditions. As the result of more recent investigations of tree groups in Western United States and Europe, Douglass has found many interesting correlations in the tree records of widely separated localities which may throw some light on the world climate of the past. Following similar lines of investigation, Dr. Huntington of Yale and his assistants have measured the rings in the stumps of 451 *Sequoia* trees, the dates of cutting of which were known. Some of the trees were only a few hundred years old when cut, nearly a hundred were close to two thousand years of age, three had lived to more than three thousand years, while the oldest registered 3210 rings. From the measurements obtained, Huntington has been able to construct a climatic curve "fairly reliable," he believes, back to a date before the beginning of the Christian era, and "moderately reliable" running back several hundred years further. Dr. Antevs, a Swedish worker, has now made a re-examination of Huntington's *Sequoia* material which relates to the period from 1000 B.C. to the present time, and although his methods in constructing a climatic curve were entirely different, the curves of climatic fluctuations correspond in striking degree with Huntingdon's results.

COTTON BREEDING IN NIGERIA.—The Empire Cotton Growing Corporation has just published a short report on the work in cotton breeding and seed supply carried on at its farm at Daudawa in Northern Nigeria (London, 1928; price 2*s*.). Broadly, there are three cotton belts in Nigeria—southern, middle, and northern, widely different in climate, agricultural practice, and political development. The southern belt grows a number of native cottons, which at best do not rise above the standard of American 'middling.' Local weaving absorbs most of the output. Southern farmers would readily grow for export

if provided with a cotton suited to their agricultural conditions and able to command a fair premium over their present varieties. From one distinctive native variety the Agricultural Department has produced by selection a strain of cotton which promises to succeed as an export cotton over considerable areas of the southern belt. The middle belt is least developed of all, but systematic investigations have been commenced on the lines which have brought success in the south. In the northern belt the American cotton 'Allen' has steadily spread in cultivation since 1912, thus creating an expanding export trade. Full export exploitation of the northern belt may demand, however, for certain areas some other variety, and investigations into the possibility of producing an improved strain of 'Allen' are already being pressed forward. In the northern belt, the question of seed supply is of some complexity. Careful study of all the facts suggests that a comprehensive organisation for seed supply is necessary. This report sets out in detail the scope and form of an appropriate machinery. It is concluded that the Corporation farm at Daudawa should endeavour without delay to produce annually 1000 acres of cotton for seed supply. The necessary expansion might be along a number of different lines, and involves intricate questions of labour and administration. Future development of the Nigerian cotton industry hinges largely on plant breeding, and for that reason the latter half of this report is devoted to a review of current problems and investigations in cotton breeding.

TOPOGRAPHIC MAPPING.—"Topographic Instructions of the United States Geological Survey. Topographic Mapping," is the title of a useful small volume that has been published as *Bulletin* 778 E of the United States Geological Survey. The book gives full instructions for field and office work, including a description with plates of all the symbols used. The work is naturally intended for officers of the United States Survey, but the instructions given should prove useful in any part of the world. The matter with regard to office work is particularly interesting, since it is not usually published in so great detail in volumes on map-making.

PHYSICS AND CHEMISTRY OF THE SANDY BEACH.—In two recent papers, Mr. J. Ronald Bruce makes some interesting contributions to the little that is already known about the biologically important physical and chemical factors of the sandy beach. The papers embody work done at Port Erin, and in the first of them ("Physical Factors on the Sandy Beach." Part 1. Tidal, Climatic, and Edaphic. *Jour. Marine Biol. Assoc.*, vol. 15, No. 2) several important points are discussed. Figures are given to illustrate the sudden change in the temperature and salinity of the shore as the rising tide washes over it. Samples of sand from different stations on Port Erin beach were separated by sieving into various grades, and the rate of evaporation, the water content at saturation, and the rate of capillary rise were determined for each grade, as well as for natural ungraded samples. It was found that while the natural ungraded sand had a much lower water content per 100 volumes of wet sand than any of the graded samples, the rate of capillary rise through it was much more rapid than through the graded samples. Grade has apparently little influence on the rate of evaporation from the surface of wet sand. The second paper ("Physical Factors on the Sandy Beach." Part 2. Chemical Changes—Carbon Dioxide Concentration and Sulphides. *Ibid.*), apart from a consideration of the rôle of calcareous matter in the sand as an alkali reserve, is devoted largely to an investigation into the constitution of the 'black-layer' which is reached at a varying depth below the surface. In this connexion an iodometric method for the determination of sulphides in sand is described, and the formation of the ferrous sulphide, to which the black colour is due, is discussed. It appears that the formation of the ferrous sulphide is associated with lack of oxygen and with bacterial action, but the precise nature of the reaction is not yet understood. The presence of organic debris seems to be essential to the reaction. Finally, a diagram is given to indicate the probable cycle of reactions through which sulphur passes on the sandy beach.

THOMAS RECORDING CALORIMETER.—The Gas Regulation Act of 1920 made provision for the continuous recording of the heating value of town's gas when satisfactory calorimeters became available. Since then much effort has been devoted to the design of suitable recording apparatus. Seeing that penalties are dependent on deficiencies in the calorific value of gas supplied, the need for vigorous sifting of the claims advanced by inventors is evident. A report has been issued (*Fuel Research Technical Paper*, No. 20. London: H.M.S.O. 9*d*. net) on the "Thomas Recording Calorimeter" introduced by the Cutler-Hammer Co., New York, and made in England by the Cambridge Instrument Co. One great difficulty of the problem is the fact that the instrument must follow and record the changes of the quality of the gas, and at the same time allow for changes of its temperature and pressure. The method adopted in this instrument is to employ air in excess as the calorimetric medium for absorbing the heat developed in the combustion of the gas. As the air/gas ratio by volume is kept constant, the temperature rise of the products of combustion should depend on the calorific value only of the gas, and this temperature rise is recorded by resistance thermometers. On gas of a steady calorific value the recorder agreed with a Boys' calorimeter to within 1 B.T.U. per cub. ft. When fluctuations occurred there was a time lag which was particularly in evidence when the fluctuations were of short duration. The recorder tended to smooth out the peaks and valleys, so that the mean value of the record was approximately correct. The calorimeter has since received official approval of the Gas Referees.

THE DISINTEGRATION OF CARBON.—*Mitteilung* No. 213, from the Vienna Radium Institute, contains an account of new work done by H. Pettersson on the supposed disintegration of carbon nuclei by α-particles made possible by the development of a technique for preparing relatively large quantities of polonium, equivalent now in α-ray activity to as much as 7 mgm. of radium. A sheet of graphite was bombarded with the α-rays from one of these sources, and the secondary rays emitted from it at an angle of about 150° with the incident beam, which were presumably mainly H-particles, were examined by the method of scintillations. Their number fell off rapidly when the air range of the α-particles was cut down by absorbing screens from 3 cm. to 2 cm., showing directly that the slower α-particles do not eject any considerable number of protons of air range less than 5 mm., and implying that an α-particle cannot effect a disruption unless its velocity exceeds some minimum value, which is more than is required in the case of alumimium, according to work by E. A. W. Schmidt in the same laboratory. As is well known, the Austrian results are not universally accepted, but detailed reports of this nature must ultimately decide between their claims and those of the Cambridge and Berlin schools.

The Seventh International Congress of Photography.

THE seventh International Congress of Photography was held in London on July 9–14, a period of three years having elapsed since the last Congress was held in Paris, in June 1925. The Royal Photographic Society, which is the premier photographic society of the world, made itself responsible for all the arrangements, and about twelve months ago it started the work of preparation, an organising committee being appointed which comprised representatives not only of photographic societies and associations, but also of the various scientific societies of Great Britain. The chairman of this committee was Sir William Pope, and the secretary, Dr. W. Clark.

As in the case of previous congresses, the seventh consisted of three sections, dealing respectively with: (1) Scientific and Technical Questions, (2) Pictorial Photography, (3) Bibliography, Record Photography, History, etc. Section (1) was divided into four subsections, dealing respectively with (*a*) Theoretical Aspects of Photography, (*b*) Photographic Practice, (*c*) Scientific Applications of Photography, and (*d*) Industrial and other Special Applications of Photography. The mere names of the sections and subsections indicate the wide scope of the subjects under consideration, although it hides such important applications as kinematography, colour photography, and photo-engraving processes, which were included under 1 (*d*). Special committees were in charge of each section and sub-section, and well-known workers in the different subjects in various parts of the world were invited to send in communications. As a result, some seventy papers were received from workers in England, the United States, Germany, France, Italy, and Switzerland, so that copious material was received for discussion at the various sectional meetings.

The meetings were held at the Imperial College of Science and Technology, South Kensington, and the Congress was opened on the morning of July 9 by Sir William Pope, who had been elected president. A large and representative gathering of workers associated with the science of photography, including delegates from the United States, France, Germany, Belgium, Italy, Switzerland, and Russia, was present, and the president was supported on the platform by M. L. P. Clerc (France), Prof. R. Luther (Germany), M. Callier (Belgium), Dr. C. E. K. Mees (America), and Mr. F. F. Renwick and Dr. T. Slater Price (Royal Photographic Society). The president, after welcoming the delegates from overseas, referred to the progress achieved since the days of the first international congress, held in Paris in 1889, and to the services rendered by photography in everyday life, as, for example, in the daily and illustrated Press. More particularly he emphasised the increasing importance of photography in its scientific applications. Whole branches of modern science are founded on photographic methods and depend for their existence on photographic aid: examples may be given in the methods of X-ray crystal analysis introduced by Sir William Bragg, and the spectroscopic study of the aurora borealis. Again, photography is an indispensable instrument in working out the conclusions of modern physics. In another direction kinematography is a popular triumph of photography, with the promise of coming new developments in talking films and films in natural colour. The president finally referred to the fact that modern photography depends mainly on the sensitiveness of silver salts, and suggested that investigation of other substances, which are known to be light-sensitive, might reveal other possibilities of practical application to photographic use.

The president then declared the Congress open, and invited the members, before the sessions of the various sections opened in the afternoon, to visit a new feature of these international congresses, namely, an exhibition of examples of nature photography, photographic survey and record work, photo-micrography and colour photography in the shape of both transparencies and prints, scientific photographs and apparatus, etc. There was also a collection of examples from British and American workers of commercial and advertising photography; in addition, many trade firms, British, American, and German, had exhibits.

Following the usual custom, the various sectional meetings, at which the proceedings were conducted in either English, French, or German, were presided over in turn by delegates chosen from the various countries represented. As can be seen from the list published in NATURE of June 23, p. 1007, the papers even in each section extended over a wide range of subjects. In many cases they gave rise to lively discussions, but their full value will only be appreciated after they, together with the discussions, have been collected together and printed in the *Proceedings* of the Congress. It may be said, however, that the riddle of photographic sensitivity and of the latent image still seems to be very far from solution. It was hoped that one of the chief objects of the Congress would be achieved, namely, the standardisation of sensitometric measurements. At the Paris Congress various recommendations of the English committee were accepted (see NATURE, **116**, 224; 1925), but were only to come into force after a period of six months if they were not objected to by any national committee. Objections were raised, however, by the committee of the Optical Society of America, more particularly with respect to the standard light source to be used, with the result that international agreement was still wanting. At the present Congress the American Committee put forward definite proposals with respect to the standard of photographic light intensity. These gave rise to a lively and animated discussion, but since they had been sent in too late for them to receive due consideration from the other national committees, it was not possible to come to a definite decision at once. The following resolution was, however, passed. It is given here because of its importance to all users of the photographic plate in scientific investigations, and it is hoped that any reader interested will send criticisms to the secretary of the National Committee on Standardisation, Dr. Slater Price.

"This meeting of the 7th International Congress recommends to the National Committees that the photographic unit of intensity for the sensitometry of negative materials shall be defined as the intensity of a source of radiation having a luminous intensity of one international candle, and produced by a grey body at a colour temperature of 2360° K., together with a selectively absorbing filter made up as follows: Two solutions compounded according to the following formula, the complete filter to consist of a one-cm.[1] layer of each solution contained in a double cell made by using three plates of borosilicate crown glass (refractive index, D line = 1·51), 2·5 mm. thick.

SOLUTION A.

Copper sulphate ($CuSO_4$, $5H_2O$)	3·707 grm.[2]
Mannite $C_6H_8(OH)_6$ . .	3·707 grm.[2]
Pyridine (C_5H_5N) . . .	30·0 c.c.
Water (distilled) to make .	1000 c.c.

[1] Tolerance in thickness shall be ±0·05 mm.

[2] For practical purposes an accuracy to the second place of decimals is probably sufficient.

SOLUTION B.

Cobalt ammonium sulphate ($CoSO_4$, $(NH_4)_2SO_4$, $6H_2O$)	26·827 grm.[2]	
Copper sulphate ($CuSO_4$. $5H_2O$)	27·180 grm.[2]	
Sulphuric acid (Sp. gr. 1·835) .	10·0	c.c.
Water (distilled) to make	1000	c.c.

It is recommended that the foregoing resolution shall come into force as a decision of this 7th International Congress if and when ratified by the National Committees represented at this Congress."

Bearing on sensitometric questions were several papers from the Eastman Kodak laboratories relating to the expression of plate speeds, the relation between time and intensity in photographic exposure, developers for sensitometric standards, a suggested systematic nomenclature for photographic sensitometry, etc., on which no definite decisions could be made, and which will form a valuable nucleus for discussion at the next congress.

The German delegates (Profs. Luther, Lottermoser, Eggert, Weigert, and Dr. Lüppo-Cramer) concerned themselves chiefly with papers touching some aspect of the riddle of photographic sensitivity, as also did the English delegates. Dr. Hamer gave an admirable summary of our present knowledge of desensitisers, and emphasised the caution with which reports on these substances should be received. Dr. Toy summarised his work on the mechanism of latent image formation (see NATURE, **120**, 441; 1927: **121**, 815; 1928) and also gave a valuable report on "Turbidity," which he had drawn up in conjunction with Messrs. Davies, Crawford, and Farrow, and which should also be of use in other industries besides the photographic industry.

The present writer is not fully acquainted with the work which was accomplished in other sections of the Congress, since he was mainly concerned with Section 1 (*a*). These sections were occupied more particularly with the applications of photography, and dealt, to a great extent, with a review of current practice and recent developments. The kinematographic group was occupied largely in the question of standardisation, and was able to put forward definite recommendations which should contribute in particular to the spread of motion-picture work among others than makers of drama films.

In addition to the various meetings of the sections there were three special lectures which members of the Congress were invited to attend. These were: "Pictorial Photography: the Relation of Technical Advance to Further Artistic Achievement," by F. C. Tilney; The Hurter and Driffield Memorial Lecture, by Dr. S. E. Sheppard, who took the latent image as his subject; and "Physics in Photography," by Dr. C. E. K. Mees. The first two were held at the Royal Photographic Society, and the last, at the invitation of, and in co-operation with, the Institute of Physics, at the Institution of Electrical Engineers. There were also motor-coach excursions to places of interest, visits to such places as the Elstree Studios, Amalgamated Press, Northcliffe House, etc. Of course there was the usual banquet, which was held on the Wednesday evening, July 11, with the president in the chair.

Especial mention should be made of the collection of British pictorial photographs and photographs of pictorial and historical interest, which was exhibited at the Royal Photographic Society, and of historical photographic apparatus exhibited at the Science Museum, South Kensington. Apart from members of the Royal Photographic Society, most people in Britain are unaware of the valuable historic collections, both of photographs and apparatus, which are to be found in the rooms of the Royal Photographic Society.

The final meeting of the Congress was held on Saturday morning, July 14. Sir William Pope was unanimously elected the president of the Permanent Committee of International Congresses of Photography, while Dr. Clark, according to precedent, was elected general secretary of the Permanent Committee. An invitation was received from the German delegates to hold the next Congress in Dresden in 1931; this was unanimously accepted. The opinion expressed by the foreign delegates was that the Congress was the most successful which had ever been held and that a standard had been set which it would be difficult to maintain. One very noticeable feature of the Congress was the cordiality prevailing between the delegates of the various nationalities present. Although agreement could not be reached upon all questions of standardisation, much was gained in social intercourse and private discussions, all of which will have its effect in future congresses.

The Great Perseid Meteor Shower.

THIS shower comes this year under rather favourable conditions, the moon being a mere crescent and not capable of interference with the display. In 1921, on Aug. 12, there was a brilliant exhibition of the meteors at about 2.30 A.M. This corresponds to Aug. 11, 1928, 9 P.M. There should be many meteors, therefore, in the evening, though the fact that the radiant is low will operate against a plentiful shower.

It will be important to notice the horary rate of appearance of the meteors, so that the time of maximum and its strength may be ascertained. The apparent paths of all the brighter meteors should be recorded accurately for the purpose of affording data for the computation of their real paths in the air. Those of the meteors which are directed in their flights from other systems than the Perseids should be specially registered, for more investigation of the secondary showers of this period is needed.

There are already many Perseid observations, and the drifting radiant has also been fully discussed. Its duration seems to extend from June 25 to Sept. 5, and the motion of its radiant is directed from $356° + 39°$ to $92° + 62°$ during the 72 days.

This shower is one of the oldest recorded in historic annals, for its initial mention is dated A.D. 714. Yet more than 1000 years elapsed before the month was specially recognised as a notable one for its meteors. The early returns of the display occurred in July, but the effects of precession have carried it forward until at the present time its chief exhibition comes on Aug. 11.

The parent comet, 1862 III, discovered independently by Tuttle and Swift in America, is a periodical one with a time of revolution about 120 years. The period of the meteors is doubtful, but there are indications of 105 years, answering to some of the best of the ancient and modern displays. I investigated the records, and found a shorter period advisable, namely, 11·72 years, which shows a singular agreement with many of the brighter and more abundant returns. The last fine shower occurred in 1921, so that if the latter period is admissible there should occur good showers in 1933, 1945, 1956, etc. This system apparently forms a complete ring, but the meteors are evidently more thickly condensed at some points of the orbit than at others.

W. F. DENNING.

University and Educational Intelligence.

APPLICATIONS are invited by the Huddersfield Education Committee for the following research scholarships at the Technical College, Huddersfield: The Drapers' Company's Research Scholarship in Dyeing, value £100 a year with remission of fees; The Joseph Blamires Research Scholarship for Research in Colour Chemistry, value £100 a year with remission of fees; and The British Dyes Research Scholarship for Research in Colour Chemistry, value £75 a year with remission of fees. Further particulars and forms of application may be obtained on application to the Technical College, Huddersfield.

DR. RONALD H. PURCELL, who was recently elected by the Trustees to a Beit Fellowship for scientific research, having declined the award owing to his acceptance of a Ramsay Memorial Fellowship, the Beit Trustees have awarded the vacant fellowship to Mr. E. C. S. Megaw, of Belfast, for research in the Electrical Engineering Department of the Imperial College of Science and Technology under Prof. Fortescue on "Properties and behaviour of the thermionic valve, particularly as a generator of radio frequency alternating current, with the object of effecting improvements in the design of the valve and its associated circuits and of increasing the existing knowledge of their functioning." Mr. Megaw was educated at Queen's University and Municipal College of Technology, Belfast.

THE report of the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1927–28 has been published, and shows every evidence of continued progress at this school. The laying down of a well-equipped petroleum laboratory, referred to in the previous report, has been fully justified by the considerable increase in the number of students attending the practical class in examination of petroleum and its products, to the extent of duplicating the normal course in this subject. The courses of lectures given include general oil technology, introduction to the chemical and physical properties of petroleum, properties and examination of petroleum, and applications of engineering and mechanical drawing. In the latter connexion the comment is rightly made that a general knowledge of the generation and transmission of power, such as is provided by this course, is essential to those clerical branches of the industry the work of which deals, *inter alia*, with engineering supplies, and it is to be hoped that this course will be more widely attended by petroleum technology students in future. Nowadays most of the larger concerns in the oil industry demand some relevant technical knowledge from their clerical staffs; advancement and promotion, in fact, are probably based more on this qualification and its practical value than on any degree of mere clerical efficiency. There is clearly no excuse for anyone, at least in London, who does not seek to equip himself with this additional knowledge. A further encouraging feature of the session's work is the initiation of research in special problems by the more advanced students; this is a particularly healthy sign, and it is to be hoped that this development will expand greatly in future.

A SURVEY of higher education in the United States during the years 1924–26, published as *Bulletin No. 34*, 1927, of the United States Bureau of Education, deals at length with the causes that have combined to provoke re-examination and re-statement of the fundamental objectives of higher education in that country. Under the pressure of unprecedented increase of student enrolments, rising costs, and political action, many institutions have been constrained to restrict within limits much more precisely defined than formerly the scope and character of their objectives. Others, and notably Catholic Church colleges for both men and women, which are being enlarged and multiplied throughout the States, attempt to meet the situation by extraordinary energy in providing increased opportunities for their increasing numbers. The survey gives prominence also to the growth of systematic and scientific study of methods and procedures. This is exemplified in the emergence of the new profession of educational adviser to the president of a university and the setting up of research bureaux in the larger universities. More and more are specific educational problems submitted to carefully planned co-operative investigation. In order to avoid waste of effort owing to the lack of a central clearing agency for such work, it is desirable, says the report, that frequent periodic reports of studies completed or under way should be embodied in a publication. It is interesting to compare with this part of the survey the remarks made by Sir Michael Sadler on Dec. 29 last in his presidential address to the Conference of Educational Associations on the neglect of scientific research in education in England, and the lack of scientific record and observation of the many educational experiments now going forward.

ADULT education in Yorkshire is reviewed in a report recently issued as *Educational Pamphlet No. 59* (pp. 54, price *1s.*) by the Board of Education. The non-vocational adult classes of Yorkshire comprise more than 10,000 students—about one-fifth of the total number in England and Wales. They include: university tutorial classes (1500 students), W.E.A. one-year and terminal classes (3600), similar classes organised by the local education authorities (5000) and other bodies (200), and 25 university extension courses. Of the various subjects studied, literature has in recent years become the most popular. Other favourite subjects are economics and industrial history, music, ambulance and first aid, home nursing and hygiene, and psychology. Classes in natural science are not so numerous, but have been successfully conducted, several being in their third or fourth year. In 1926–27 there were 10 classes in biology, 2 in geology, and 2 in general science. Laboratory accommodation is provided at Leeds and Sheffield by the universities, and elsewhere by secondary schools, local resources being supplemented by the microscopes, slides, and material conveyed by the lecturer to the various centres. It is clear, says the report, that the 173 classes, comprising 5000 students, provided directly by the local education authorities, are reaching a body of people whose requirements are not met in any other way—notably people for whom book-learning has no attractions. Half of these students are manual workers, more than a quarter are women whose main occupation is household duties, and most of the remainder are engaged in clerical occupations or teaching. The subjects studied by them are chiefly ambulance and first aid, etc. (47 classes), music (34), home-nursing and hygiene (28), handicrafts (21), literature (13), and dress-making. The report is not merely statistical, but includes a critical survey of the adult education movement and estimates the value of its achievements and prospects.

Calendar of Customs and Festivals.

August 15.

THE ASSUMPTION OF THE BLESSED VIRGIN MARY.—"The greatest of the festivals the Romish Church celebrates in her honour"; but it is to be noted that though the ritual is ecclesiastical in the main, the festival is essentially popular in character. At Marseilles, for example, a festival was held on the highest of the mountains outside the town where there once stood the chapel of "Notre Dame des Anges," destroyed in the revolution. Here the peasants from all the country round assembled in their best clothes and spent the day in sport. One of the most celebrated and elaborate of these festivals was held at Messina. It was known by the name of "bara," from an erection of about fifty feet in height which was carried in procession. This erection represented Heaven, and was divided into several stages. On these children represented the Virgin and Child, cherubim and seraphim, and the apostles, while four children were attached to the principal radiating arms of a revolving sun.

At Dieppe a Guild of the Assumption was founded in 1443 in memory of the defeat of the English. For the feast a girl of exemplary character was chosen to represent the Virgin, and six others, her handmaids, represented the "Daughters of Zion." A St. Peter, specially associated with the Virgin, was chosen from the clergy, while the laity furnished the remaining eleven apostles. On the day preceding the feast, the Virgin was laid in a cradle resembling a tomb and carried to the Church of St. Jacques. On the morning of the 15th, a procession, including the dignitaries of the town and youths of both sexes, dressed to represent their patron saints, escorted the Virgin with her attendant handmaids and apostles from the church of St. Jacques to the church of St. Remi, where a *Te Deum* commemorated the defeat of the English. During the service a representation of the Assumption took place on a scaffold reaching nearly to the dome of the church. On this, God and a number of angels appeared. An essential part of the representation was a buffoon who came out at the moment a pasteboard figure of the Virgin, which had been substituted for the girl personating her, after being elevated to the upper stages of 'Heaven,' disappeared behind the clouds and the angels extinguished their tapers. The buffoon, after various capers, in the course of which he simulated death, took refuge beneath the legs of God, where his head alone showed.

In Italy in ancient times, on Aug. 13, a Feast of Diana was celebrated by the husbandmen to secure the fertility of their crops—as the peasants nowadays invoke the Virgin at the Assumption to give prosperity to their vines—and the shrine of Diana in the Grove of Nemi was visited by a multitude of pilgrims who invoked her as the goddess of fertility. At Nemi, Diana was associated with a priest-king, and it is at least a coincidence that in the Christian observance the Virgin should also be associated with a male figure—at Dieppe St. Peter, who is specially set apart from the other eleven apostles, and later with the buffoon, who in his antics and his simulation of death recalls the pantomimic fertility figures of pagan and popular observance. It is generally agreed that these elaborate Assumption festivals of Roman Catholic countries mark the adoption of the fertility festival of a pagan goddess represented at Nemi by Diana. The late date of the institution of the Assumption—it is said to be of the seventh century—and its association with a fifteenth-century foundation in France, point to a popular festival of long standing and deep rooted, which the Church had finally to recognise and accept.

The Assumption of the Virgin and the Dianic festival appear to belong more particularly to the southern area of Europe. In Britain the Assumption is also associated with fertility, but in connexion with first-fruits. It was customary in some localities for all fruits, vegetables, and herbs to be taken to the church on this day and consecrated against evil. Thereafter charms could be wrought by their means, and if thrown in the fire they effectively drove away witches and other evil things.

On Aug. 15 the Minstrels' Feast took place at Tutbury, in Staffordshire, when Needwood Forest had to supply two bucks, one for the feast held at the Castle, and one for the prior of the Abbey. A buck's head was carried in procession decked with bacon and pease, each one taking a part in the procession carrying a green bough. At the church a mass was said, and each minstrel offered a penny. On the following day a court was held, at which a king of the minstrels of Derbyshire and Staffordshire for the following year was elected. All undertook to abide by his rule. After a dinner the prior of the Abbey gave a bull, which was let loose when the tip of his horns, his ears, and tail had been cut off, his body smeared with soap, and his nostrils filled with pepper. If any minstrel could cut a piece from his hide before he crossed the Dove he belonged to the king of the minstrels; if not, he was returned to the prior. In the former case he was baited three times with dogs.

August 16.

ST. ROCHE OR ST. ROCK.—Smitten with pestilence while on a pilgrimage to Rome, he was cured by the intervention of an angel and became the patron of all afflicted with the plague. His festival was kept in England as a wake or harvest home, dances taking place in the churchyard in the evening.

August 18.

ST. HELENA.—It has been suggested that, as in the cult of St. Helena, Empress of Constantinople, her festival falls on this day, it is therefore to be associated with an older cult, that of the Twin Brethren, Castor and Pollux, the one divine, the other human. This might well arise from a confusion with Helen, their sister. The Byzantine calendar, as well as others, records the festivals of twin saints on this day, namely, Florus and Lorus. The Russian peasants regard these saints as the patrons of horses, while in the Greek Church they are twin brethren who were stone masons. In the Syrian Church they are also twins. The Dioscuri, Castor and Pollux, were patrons of horses and of building, as well as connected with the sea; but, in addition, their cult was closely related to that of the sky-god, as their name Dioscuri indicates. It has therefore been suggested that their cult survives in the cult of some of the twin or coupled saints, of whom there are several examples in the Christian calendar. For example, Cosmas and Damian, patrons of sailors, and also popularly invoked as healers; Protasius and Servasius, the Tergemini at Langres, Nearchus and Polyeuctes, as well as St. Thomas, especially in connexion with his activities in India, and his relation to Christ. There are Indian and Persian parallels, such as, for instance, the Vedic Açvinau, the horsemen of the sun, while beliefs relating to twins among primitive peoples also point in the direction of a belief in the supernatural origin of at least one member of the pair, and of a sky and fertility cult. (*See* J. Rendel Harris, "Boanerges," Cambridge, 1913.)

Societies and Academies.

PARIS.

Academy of Sciences, June 11.—The President announced the death of Luigi Bianchi, Correspondant in the section of Geometry.—**Mandelbrojt** : Remarks on the theorem of composition of normal families of functions.—**E. Cartan** : Complete orthogonal systems of functions in certain closed Riemann spaces.—**Frontard** : The profiles of coherent soils with a plane surface of slip.—**Th. De Donder** : The extension of the Einstein gravific to thermodynamics.—**E. Pierret** : The realisation and working of a new oscillator producing very short waves. In an earlier communication a means of obtaining very short waves (14 to 18 cm.) has been described, for the good working of which two absolutely identical valves are required, a condition difficult to realise. An apparatus giving similar waves, but requiring only one valve, has now been constructed and details are given.—**Edmond Rouelle** : The use of the ferromagnetic frequency demultiplier as a phase multiplier.—**A. Turpain and R. de Bony de Lavergne** : An ultramicroscope of very reduced dimensions and the researches possible by its aid.—**L. Décombe** : Electrified spherical pellicles and the Compton effect.—**Edmond Bayle and Lucien Amy** : The use in analysis of a mercury cathode with falling drops. A diagram is given of an apparatus for delivering the mercury drops rapidly and at a constant rate of flow. Examples are given showing some applications of the apparatus to analysis.—**G. Siadbei** : A new photographic sensitometer. The apparatus described gives quantitative measurements on the homogeneity of the photographic emulsion and its relations to light.—**Marcel Frilley** : The spectrography of the X-rays by crystalline diffraction. Completing an earlier communication, some fainter lines in the X-ray spectrum of RaC have been recorded, one of which has a wave-length as short as 16 UX (770 kilovolts).—**W. Broniewski and L. Sliwowski** : The structure of the tin antimony alloys. Earlier work on these alloys has led to rather indefinite results. The authors' work includes measurements for a series of alloys of the electrical conductivity, the thermo-electric power, the temperature coefficients of the electrical resistance, and of the thermo-electric power, the E.M.F. of solution, the coefficient of expansion, and its variation with temperature, the hardness, micrography, and thermal analysis. Only one compound is clearly indicated, Sn_3Sb_2.—**J. Huggett and G. Chaudron** : The thermomagnetic study of ferric oxide attracted by the magnet. Malaguti's oxide, at a sufficiently high temperature is irreversibly transformed, with heat evolution, into ordinary ferric oxide, not attracted by a magnet. Traces of impurities modify the phenomenon considerably.—**Mlle. J. S. Lévy** : Adsorption in binary systems.—**J. W. Nicolaïeff** : The allotropic modifications and solid solutions of phosphorus. Measurements of density, vapour pressure, temperature of inflammation, and melting-point prove the existence of four allotropic modifications of phosphorus, which form between themselves a continuous series of solid solutions. Red phosphorus is not one of the allotropes.—**Ch. Courtot, L. Nicolas, and Tchang Han Liang** : Contributions to the study of diphenylene sulphide.—**Mme. Ramart-Lucas and Anagnostopoulos** : The comparative stability of different isomers according to their absorption spectrum. Transpositions in the series of the 1-aryl-2-phenyl-2-ethyl-1-butanols. **P. Carré** : Benzylchlormethyl oxide : the formal of benzyl alcohol.—**Marc Chambon** : A new synthesis of tropic acid. Bromophenylacetic ester,

$$C_6H_5 \cdot CHBr \cdot CO_2C_2H_5,$$

is condensed with trioxymethylene in benzene solution in the presence of finely divided zinc. The yield is over 50 per cent. of the theoretical.—**Const. A. Ktenas** : The presence of alkaline lavas in the northern Ægean sea.—**Marcel Casteras** : The structure of the Bessède (Aude) massif and on its tectonic relations with the massif of Saint-Barthélémy (Ariège).—**Georges Corroy** : The vertebrates of the Lorraine Trias.—**S. Thoulet** : Submarine basins produced by subsidence.—**Henryk Arctowski and Edward Stenz** : The fall of dust in Poland on April 26–28, 1928. This dustfall, the first on record in Poland, gave deposits varying from 2 grams to 31 grams per square metre. Reasons are given for supposing that this dust was carried from central Russia.—**Ch. Maurian and L. Eblé** : The diurnal variation of magnetic disturbance at the Val-Joyeux, near Paris. The daily magnetic disturbance was independent of the solar activity. There is a marked minimum throughout the year at about 8.0 A.M., with two maxima at 1.0 P.M. and 10 P.M.—**Marcel Mascré** : The staminal tapetum and pollen grain of *Arum maculatum*.—**A. Maige** : The physiological conditions of the unilocular or plurilocular amylogen reaction of the plasts.—**A. Demolon, H. Burgevin, and G. Barbier** : The clay colloids and solutions of soils.—**J. Chaussin** : Study of the internal medium in the different organs of the potato in course of development.—**G. Th. Dornesco** : Researches on the morphological constituents of the fibrous cells of the hepatopancreas of the crayfish, and, in particular, on the relations of the Golgi apparatus and the vacuome.—**Auguste Lumière and Mme. Grange** : The comparative alexic powers of the sera of arterial blood and venous blood. The alexic power of these sera is dependent, at least in part, on the amount of carbon dioxide present.—**J. M. Le Goff** : The differential vasodilating action of cobalt and nickel chlorides. Although the toxic action of nickel is identical with that of cobalt, there is a marked difference between the effects of the intramuscular injection of salts of these two metals ; a cobalt salt produces expansion of the blood vessels and redness in the face, nickel salts are without action. Considering the close chemical relations of these two metals, this physiological difference is remarkable.—**Maurice Piettre** : Some chemical and physical properties of the proteins of the serum. The proteins cannot be considered as buffer substances, this function apparently belonging to the mineral or organic impurities which are normally present.—**V. Chorine** : The immunisation of the caterpillars of *Galleria Mellonella* against *Bacterium galleria* No. 2.

Academy of Sciences, June 18.—**Marcel Brillouin** : Mixed conditions at the frontiers. Oceans and continents. Static tides.—**P. Villard** : The chemical actions of radiations. Remarks concerning an interpretation. Discussion of a recent communication by H. Belliot on the action of light on a photographic plate.—**Charles Moureu, Charles Dufraisse, and Marius Badoche** : Autoxydation and antioxygen action. The catalytic actions of phosphorus. Details of experiments on the oxidation of furfurol by gaseous oxygen, alone, or in presence of 1 per cent. of solid white phosphorus.—**A. Blondel** : The transformation of a luxmeter into a brilliancy meter.—**René Maire** : The vegetation and the flora of the Hoggar (Central Sahara). The study of the flora of Hoggar shows that it is formed of tropical and Mediterranean survivals, for the most part adapted to present conditions. Many of these represent survivals from a climate much more moist than exists at present. These conclusions are in agreement with those drawn from geological, geographical, and zoological data.—**Louis Blaringhem** was elected a member of the section of

botany, in the place of the late L. Guignard.—**W. A. Tartakowsky**: The determination of the totality of the numbers represented by a quaternary positive quadratic form.—**Sophie Piccard and D. Mirimanoff**: Binomial curves.—**J. v. Neumann**: The theory of games of chance.—**V. Hlavatý**: The coefficients of Ricci.—**Marcel Vasseur**: The permanent conjugated systems in the deformation of a surface.—**Paul Alexandroff**: The frontiers of connected domains in space of *n* dimensions.—**B. de Kerékjártó**: An elementary demonstration of a theorem of translation due to M. Brouwer.—**Léon Pomey**: A general property of differential equations (ordinary or partial) and of integral equations.—**D. Th. Egoroff**: Some points of the theory of integral equations with fixed limits.—**Benjamin Meisel**: The torsion of prismatic bodies.—**J. Schokalsky**: The oceanographic expedition to the Black Sea.—**Raoul Ferrier**: The amperian in the theory of spectra.—**A. Bogros and Y. Rocard**: Remarks on the Raman and Cabannes-Daure effects.—**J. Cabannes**: The experimental laws of the Raman effect and the theories of light.—**Mlle. M. Hanot**: Researches on the hydrogen lines in the electric arc. The arc between metallic electrodes in hydrogen is rapidly extinguished and a special device required to overcome this difficulty is described.—**H. Volkringer**: Continuous spectra and band spectra of zinc vapour. For low vapour pressures, a spectrum is obtained which appears to be connected with the line spectrum; with higher vapour pressures of zinc a band spectrum is formed between 2975 A. and 4800 A.—**Jean Becquerel and W. J. de Haas**: The decomposition of the Faraday effects into two phenomena of different origins. Diamagnetic rotatory polarisation and paramagnetic rotatory polarisation.—**Mme. Irène Curie**: The number of ions produced by the a-rays of RaC′ in air.—**Maurice Auméras**: The state of ionisation of solutions of hydrogen sulphide.—**Paul Riou and Paul Cartier**: The influence of viscosity on the absorption velocity of carbon dioxide by solutions of neutral sodium carbonate. Viscosity may have some influence on the velocity of absorption of a gas by a liquid, but in no case is it the main factor.—**Pierre Brun**: The heat of formation of partially miscible water alcohol mixtures.—**Joseph Loiseau**: Contribution to the study of the copper alloys by the diffraction of the X-rays. Copper and two brasses, 67/33 and 60/40, were examined from the point of view of the changes in the Laue radiograms brought about by annealing from different temperatures.—**Albert Roux and Jean Cournot**: The crystallographic study by means of the X-rays of the structure of simultaneous metallic deposits of two metals. The spectra of the simultaneous deposits are not simply the spectra of the two metals superposed, showing that during the deposition the two metals form either a solution or compounds.—**L. Andrieux**: The preparation and properties of a cerium boride. The electrolytic bath consisted of mixtures of cerium oxide, boron trioxide, and cerium fluoride; these were found to give homogeneous liquids at a temperature of about 1000° C. Electrolysis gave violet-blue crystals of the boride CeB_6. Better yields were obtained when the cerium fluoride was replaced by lithia and lithium fluoride.—**Jean Savard**: Absorption curves of the pulegonols. Description of the changes brought about in the absorption spectrum by conversion from the ketonic to the enolic form.—**Mikaïlovitch Jélénko**: Earthquakes in Bulgaria in 1928; the geological situation of the devastated regions and various dislocations.—**C. Dauzère and J. Bouget**: The intense ionisation of the air in places frequently struck by lightning. It has been proved that there are certain spots in which the ionisation of the air in the neighbourhood of the soil is more intense than that observed in the neighbourhood, at the same altitude and under the same physical conditions. Places which are frequently struck by lightning coincide with these spots of maximum ionisation, the situation of which depends on the geological constitution of the soil.—**J. Bougault and E. Cattelain**: New researches on the etholides of the waxes from Coniferæ. Juniperic acid has been proved to be present in the wax from certain Coniferæ, but in proportions too small to serve as a base for the preparation of compounds possessing the odour of musk.—**H. Janvier**: The regime of *Opisthopatus Blainvillei*.—**A. Mordvilko**: A new contribution to the study of anolocyclia in the Pemphigians of Pistachia.—**René Hazard**: The cardiovascular action of tropinone.—**J. E. Abelous and H. Lassalle**: The action of the aqueous extract of nerve substance on the excitability of the nervous system.—**Mme. M. Phisalix and F. Pasteur**: The action of ultra-violet rays on the serum of *Vipera aspis*.—**W. Kopaczewski**: The electrocapillary penetration of colouring matters into the cell.—**Marcel Avel**: Nutrition and sexuality in Lumbricus.—**S. Posternak**: The limit of degradation of the lectotyrines by trypsin.—**Raymond Poisson**: *Eccrinopsis Mercieri*, a parasite of the rectum of *Oniscus asellus*. Its evolutive cycle.—**E. Nicolas and J. Lebduska**: The comparative study of the action of urea and of thiourea on the development and vitality of bacteria. Thiourea has a toxic action, definitely greater than that of urea, on the development and vitality of the micro-organisms examined. A similar effect has been proved by E. and G. Nicolas for plants, although less marked. On the other hand, for animals the toxicity of urea is greater than that of thiourea.—**Henri Jean Frossard**: A mechanical theory of deafness, its rational treatment and prophylaxy.—**G. Delamare and C. Gatti**: The evolution of the cysts of the Paraguay Piedra.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 4).—**S. Bernstein**: The sums of dependent quantities.—**N. N. Kalitin**: The variation in the total intensity of the solar radiation during the solar eclipse of June 29, 1927. Determinations of the variation and discussion of results.—**P. J. Schmidt**: A rare Japanese shark, *Calliscyllium venustum* Tanaka. Supplementary description, with figures.

Comptes rendus, No. 5.—**B. Koupletsky**: The mineralogical composition of apatite-nephelic rocks from the Khibin tundra. Quantitative mineralogical analyses of apatite rocks from the Khibin mountains show that in some of them apatite predominates, while in others its place is taken by nepheline; other minerals present are egirin, sphen, biotite, and titanomagnetite.—**V. Sukatchev**: Flora of post-tertiary deposits at Troitskoe near Moscow. A study of fossil plants found in various layers of the deposits shows that they correspond to three climatic phases. The first was a cold phase, with a predominance of *Picea obovata* and *Pinus sylvestris*. The length of this period is estimated at about 4000 years. Next came a warmer phase when oaks (*Quercus pedunculata*) predominated, while other broad-leaved trees, like *Acer*, *Alnus*, *Fraxinus*, *Betula*, etc., were also abundant; this phase lasted about 1500 years. The third period, the length of which is estimated at about 3000 years, corresponded, perhaps, to a steppe period, but no fossils of certain age were found in the corresponding layers.—**B. Vishnevsky**: Contributions to the study of blood groups in the peoples of Russia. Agglutination reactions of the blood of some thirteen different nationalities were studied and preliminary figures and classification are offered.—**B. Zemliakov**:

Prehistoric man in north-west Russia in relation to the geological history of the region during the post-glacial period. A study of pottery and other objects found in eleven different places and correlation in the development of the technique of their production with geological periods.

Comptes rendus, No. 6.—G. Gamburtsev: Apparatus for the mechanical determination of elements of the magnetic and gravimetric field produced by an infinite cylinder of arbitrary section.—V. Kustov: Analysis of the water of an arsenic containing spring in Caucasus. Water of a spring in the Araxes valley contains 0·048 gm. per litre of Na_2HAsO_4, which is one of the highest known figures of arsenic content in mineral waters.—V. Lodyzhenskaya: Transplantation of regenerated extremities of axolotl. Experiments were made with transplantation of regenerated extremities while still in the stage of a bud. It was found that the buds are already strictly determined as regards their orientation (anterior, posterior, left or right) after the second day.

ROME.

Royal National Academy of the Lincei, April 1.—C. Somigliana: Normal gravity and Helmert's formula.—U. Cisotti and B. Finzi: Observations on Straneo's note on the Kutta-Joukowski theorem. The validity of the exception to this theorem indicated by Cisotti is upheld.—L. A. Herrera: Imitation of organic forms by means of albumen (2). When drops of natural egg-albumen are dropped from a height on to the surface of hydrochloric acid or Merck's solid egg-albumen, or flakes of dry egg-white are deposited on the surface of the acid, forms develop which closely resemble those of infusoria.—M. Pascal: The rectilinear laminar profile. A new proof of the non-existence of Cisotti's exception to the Kutta-Joukowski theorem is developed.—L. Laboccetta: Analytical expression of discontinuous physical magnitudes or functions of discontinuous variables and diagrams corresponding therewith.—A. Rosenblatt: Pistolesi's note on a supposed exception to the Kutta-Joukowski theorem. The author replies to Pistolesi's recent criticism of his demonstration of the non-applicability of the Kutta-Joukowski theorem in exceptional cases and insists on the significance of the formula developed in his previous note. In reply to Pistolesi's note, Cisotti has lately communicated certain considerations on the method of evaluating the resultant of the dynamic actions affecting an indefinite plate subjected to a translatory-circulatory current investing it and surrounding it, and has expressed the opinion that Pistolesi does not take into account, in an orthodox manner, the singularities at the extremities of the plate.—G. Krall: Limits of the dynamic effort in dissipative systems.—F. Rasetti: Enlargement of spectral lines. Due importance has perhaps not been attached to the influence, on the broadening of spectral lines, of the perturbation produced in an emitting atom by similar neighbouring atoms; for a phenomenon analogous to resonance, such perturbation would be far greater than that due to atoms having different proper frequencies, and might result in sensible alteration of the frequencies emitted, and hence in broadening of the line. A brief outline of the theory of the phenomenon is given, together with the results of experiments on sodium, these indicating that the depth of the luminous vapour cannot explain the widening, unless the existence of the resonance effect is assumed.—A. Carrelli: Relativity in five dimensions.—G. Todesco and B. Rossi: Study of imperfect metallic contacts. Pélabon has recently shown that an imperfect contact between two electrodes of the same metal but of different shape may serve for the rectification of oscillating currents, and hence may replace the crystal or thermionic valve detector. By means of an apparatus with steel electrodes which allow of constant contact resistances of some hundreds of thousands of ohms being obtained, the characteristic curves for these contacts have been investigated. Such a contact does not follow Ohm's law, but its resistance diminishes as the current intensity increases. This variation in resistance, which is perfectly reversible, is, however, accompanied by an irreversible diminution in resistance whenever the current traversing it exceeds, in absolute value, the maximum previously reached during the experiment. Further results show that the passage of a current, even of extremely low intensity, through the imperfect metallic contact, coheres it, rendering it inactive to rectification. In order that the latter may occur, it is necessary that the contact should resume immediately its original resistance. This may happen, in particular, when, as with Pélabon's contacts, the electrodes possess a certain mobility which permits of the continuous interruption of the incipient process of coherisation.—O. Specchia: An interferential method for the measurement of the magnetic susceptibility of liquids. The method described represents a modification of the Fabry-Quincke method.—M. L. Pagliarulo: Considerations on F. P. Mazza's criticism. Mazza's criticisms of the author's work on the rotatory dispersion of the alkyl aspartates are invalid, since the experiments were carried out with all the precautions necessary to ensure accuracy of the results.—F. Principi: Miocenic deposits between the valleys of Senio and Sillaro.—L. Settimj: The chemical composition of certain Italian milk foods. Results are given of analyses of Roman *ricotta*, which is made by heating whey, obtained by the coagulation of milk by rennet for making cheese, to 75°-80° in the presence of an organic or mineral acid and thus precipitating the protein substances, and of the somewhat similar material known as *mozzarella*.—P. Pasquini: Experimental investigations on the embryology of the echinoderms (2). Polar differentiation of the ova of *Arbacia punctulata* Grey, centrifuged immediately after fertilisation.

Official Publications Received.

BRITISH.

Royal Society of Arts. Cantor Lectures on Scientific Foundations of the Refining of Petroleum, delivered before the Royal Society of Arts on January 16th, 23rd and 30th, 1928. By Dr. A. E. Dunstan. Pp. 95. (London.) 3s.

Forestry Commission. Report on Census of Woodlands and Census of Production of Home-Grown Timber, 1924. Pp. 68. (London: H.M. Stationery Office.) 1s. 9d. net.

Annual Conference of the Universities of Great Britain and Ireland, 1928: Report of Proceedings. Pp. 48. (London: Universities Bureau of the British Empire.) 1s.

The Journal of Physiology. Author Index to Volumes 1 to 60. Issued by the Physiological Society and published as a Supplement to *The Journal of Physiology*, June 1928. Pp. ii+235. (London: Cambridge University Press.) 25s. net.

The North of Scotland College of Agriculture. Calendar, Session 1928–1929. Pp. vii+127. (Aberdeen.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 15, Technological Series No. 10: The Effect of using Unbalanced Drafts instead of Balanced Drafts in the Spinning Preparation for Spinning Tests. By A. James Turner. Pp. ii+30. (Bombay.) 1 rupee.

Is an International Language Possible? A Lecture delivered before the Annual Conference of the Société Internationale de Philologie, Sciences et Beaux Arts, London. By E. Sylvia Pankhurst. (Interlingua Pamphlets, 1.) Published for the Academia pro Interlingua, British Section. Pp. 29. (London: Morland Press.)

Transactions and Proceedings of the New Zealand Institute. Vol. 59, Part 1. Pp. iv+211+38 plates. (Wellington, N.Z.)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1927. Pp. 22. (Adelaide: Harrison Weir.)

University of Reading: The National Institute for Research in Dairying. Annual Report, for the Year ending 31st July 1927. Pp. 70. (Reading.)

Educational Broadcasting. Report of a Special Investigation in the County of Kent during the Year 1927. Pp. ix+80+xxxii. (Dunfermline: Carnegie United Kingdom Trust.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 5: *Sulpingium Palinorsum*, a new Carboniferous Coal. By Dr. Louis B. Smyth. Pp. 39-42+2 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

Department of Scientific and Industrial Research. Building Science Abstracts. Compiled by the Building Research Station and published in conjunction with the Institute of Builders. Vol. 1 (New Series), No. 6, June. Abstracts Nos. 952-1160. Pp. v+157-194. (London: H.M. Stationery Office.) 9*d.* net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1140 (Ae. 309): Notes on Performance Testing. By H. L. Stevens and A. E. Woodward Nutt. (T. 2569.) Pp. 8+6 plates. 6*d.* net. No. 1145 (Ae. 313): Wind Tunnel Tests on a R.A.F. 15 Aerofoil with Pilot Planes. By F. B. Bradfield and K. W. Clark. (T. 2545 and a.) Pp. 17+15 plates. 1*s.* net. (London: H.M. Stationery Office.)

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 1, Part 3, July. Edited by Prof. H. W. Turnbull. Pp. 139-188. (London: G. Bell and Sons, Ltd.)

The Research Association of British Rubber and Tyre Manufacturers. Summary of Current Literature. Vol. 6, No. 3, March. Pp. 178-257. Library Catalogue, June 30, 1927. Pp. 210. (Croydon.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1927. Pp. 222+10 plates. (Bristol.)

Journal of the Chemical Society: containing Papers communicated to the Society. July. Pp. iv+1741-1991+x. (London: Gurney and Jackson.)

Report of the Geological Survey of the Anglo-Egyptian Sudan for the year 1926. Pp. 9. (Khartoum: Sudan Government Education Department.) 5 P.T.; 1s.

Empire Cotton Growing Corporation. Report of the Executive Committee, to be submitted at the Meeting of the Administrative Council on July 26th, 1928. Pp. 8. (London.)

Technical College, Bradford. Diploma and Special Day Courses. Session 1928-29. Pp. 218+26 plates. (Bradford.)

Ministry of Agriculture and Fisheries. Third Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 141+22 plates. (London: H.M. Stationery Office.) 5*s.* net.

Aeronautical Research Committee. Report for the Year 1927–28. Pp. 63. (London: H.M. Stationery Office.) 2*s.* net.

Transactions of the Mining and Geological Institute of India. Vol. 22, Part 2, May. Pp. 69-176+plates 11-26. (Calcutta.) 2.8 rupees.

Memoirs of the Queensland Museum. Vol. 9, Part 2, June 16th. Pp. 127-206+plates 18-26. (Brisbane: A. J. Cumming.)

Reports of the Great Barrier Reef Committee. Vol 2. Pp. xvi+114+12 plates. (Brisbane: A. J. Cumming.) 10*s.*

Proceedings of the Cambridge Philosophical Society. Vol. 24, Part 3. Pp. 357-469. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1146 (Ae. 314): Full Scale and Model Measurements of Lift and Drag of a Bristol Fighter fitted with R.A.F. 34 Wings. By J. K. Hardy and A. S. Hartshorn. (T. 2565.) Pp. 9+9 plates. 9*d.* net. No. 1147 (Ae. 315): Wind Tunnel Tests of Aerofoil R.A.F. 36. By F. B. Bradfield and K. W. Clark. (T. 2577.) Pp. 5+42plates. 6*d.* net. (London: H.M. Stationery Office.)

FOREIGN.

Treasury Department: United States Public Health Service. Hygienic Laboratory Bulletin No. 151: Studies on Oxidation-Reduction, 1-10. By the Staff of the Division of Chemistry. Pp. vi+363. (Washington, D.C.: Government Printing Office.) 50 cents.

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Diary of Societies.

SATURDAY, AUGUST 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—Annual Meeting.

CONGRESSES.

AUGUST 12–18.

INTERNATIONAL CONGRESS OF ENTOMOLOGY (at Cornell University, Ithaca, New York).

AUGUST 20–25.

INTERNATIONAL CONGRESS AGAINST ALCOHOLISM (at Antwerp).—Sir Arthur Newsholme: The Alcohol Question and Social Hygiene.—Prof. Firket: The Concentration of Alcohol in the Blood and the Diagnosis of Drunkenness from the Medico-legal and Insurance Aspects.—Prof. Laitinen: Recent Experiments on Alcohol and Heredity.—Dr. Puusep: Changes in the Endocrine Glands in the Descendants of Alcoholics, the Endocrine Glands and Inebriety, the Permeability of the Meninges in Alcoholics, and the Excitability of the Cerebral Tissue in the Descendants of Alcoholics.—Prof. H. Emerson: Results of American Prohibition from the Hygienic Aspect.—Drs. Vervaeck and Meeus: Social Effects of the Belgian Liquor Law of 1919.—Dr. Dahlgren: Alcoholism in Russia.—Drs. Bellin du Coteau and Bergeron: Alcohol and Sport.

SATURDAY, AUGUST 18, 1928.

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Normal and Supernormal Phenomena.

ABOUT two years ago a plea was made in our columns by Dr. R. J. Tillyard for a wider and more generous outlook on the part of science towards psychical research. The correspondence which followed showed that one of the reasons why scientific investigators hesitated to undertake research into these problems was the uncertainty that, however faithfully they might follow up clues, they were unlikely to be able to reach precise conclusions. There are so many unsolved problems in the natural world to attract the attention of scientific workers, and so many natural mysteries from which they may be able to lift a corner of the veil, that however willing they may be to enter into the field of supernatural or supernormal manifestations, the claims of normal facts and phenomena are too strong to permit them to do so. If few men of science devote themselves to "the scientific study of what are called supernormal phenomena" it must not be assumed, therefore, that they are altogether indifferent to observations and conclusions in that field, any more than it can be assumed that students of atomic constitution have no interest in the structure of the cell.

We ourselves preserve an open mind towards work for the advancement of knowledge and the acquisition of truth in all spheres of intellectual activity. It is on that account that we publish this week an article by Dr. R. J. Tillyard in which he presents evidence, regarded by him as sufficient, of the survival of a human personality. The search for evidence that human personality survives the shock of physical death, and that, after severance from the body, it can continue to function on some other plane of existence, will no doubt be prosecuted so long as man possesses that curiosity from which discoveries are born. Dr. Tillyard is one of those who, much to his credit, has decided to make his contribution to the problem by both a consideration of, and practical experience with, those obscure and hotly debated phenomena which form the subject matter of psychical research.

In his article published in this issue of NATURE, he describes certain of his experiences, and as a result he has come to the conclusion that a certain human personality who parted from his body in 1912 has "fully proved *in a scientific manner*" that he has survived physical death. Now it is a little difficult to suppose that the experiences related by Dr. Tillyard have been the sole means of convincing him of the truth of such a momentous question. Such a supposition would scarcely be

fair to him. We must imagine that these experiences have been the culmination of a series of other incidents observed elsewhere, which, so to speak, have tipped the scale in favour of the hypothesis of survival. This assumption is made because, from a consideration of Dr. Tillyard's remarks, it is not easy to understand on what he bases the "*scientific proof* of survival" which he believes to have discovered in the evidence presented. It may be of interest to indicate a few of the points in his article which must occur to any one at all acquainted with the methods by which inquiries into 'psychical' phenomena are usually conducted.

Dr. Tillyard divides his experiences into two parts—(*a*) Supernormal Cognition of Unknown Objects, and (*b*) Supernormal Production of Thumb Prints. Now it would seem fairly clear that in the Margery mediumship we have the choice of two alternatives. Either the phenomena are 'supernormally' produced in the sense in which Dr. Tillyard uses that term; or they are the result of normal methods which have deceived the observers. In other words, Margery is either the instrument of some unrecognised 'Forces'; or she, and possibly others, are engaged in a mystification for some undisclosed purpose. There seems no doubt that Dr. Tillyard prefers the first hypothesis, which he has somewhat elaborated so as to include the survival of an active human personality.

Let us briefly examine his evidence. Dr. Tillyard tells us that for the alleged supernormal cognition of unknown objects he "proceeded to make the following preparations for supernormal tests." Now the inadequacy and oddity of these tests must strike even the most casual reader. We do not know who actually invented these tests, but it would seem probable that they were devised by the control 'Walter,' or, in other words, on the hypothesis of normal action, by the medium and her associates. If this were so, Dr. Tillyard and Mr. Evans were merely the instruments used in preparing experiments devised by others—not altogether a satisfactory beginning of a test for supernormal activity. Moreover, it is 'Walter' who arranges the sitting and tells Dr. Tillyard when preparations are complete for examining the calendar, the diagrams, or the magazine.

We find it difficult to imagine what possible reason Dr. Tillyard can have for supposing that anything supernormal was in progress during the acquisition of knowledge regarding these objects. We do not deny that supernormal activity *may* have been present, but we would submit that the experiments were unsuitable to demonstrate it.

Had 'Walter' given the order of the calendar sheets before they left Dr. Tillyard's pocket it might have been more difficult to seek a normal explanation. Had he described Mr. Evans's diagrams in a similar way it might have been worth our careful attention. But he did neither of these things. He took away the calendar and the diagrams and returned them later. Doubtless Dr. Tillyard will say that he took them away in order to read them: others may think they were taken away for some one else to read them.

The difficulty of darkness is not one which even a moderate ingenuity could fail to surmount. All that is required, therefore, upon the hypothesis of normal procedure, is that someone saw the objects handed over by Dr. Tillyard and Mr. Evans, and that Margery, having acquired knowledge of them, wrote it down afterwards. It would seem that any one could produce the same 'phenomena' under the same conditions with some degree of practice, provided he desired to do so. Similarly, if we assume that Mrs. Litzelmann was willing to assist, why is it difficult to explain her knowledge of the calendar numbers? Dr. Tillyard says of the calendar sheet (May 8) torn from the block at the sitting that the 8 was "My number." It was nothing of the sort. It was 'Walter's' choice from a set of 31 sheets. By signing *all* the sheets of both months Dr. Tillyard and Mr. Evans themselves provided the means for prearrangement, and what we should like to know is whether or no they did this under instruction. Again, why did Mr. Evans make ten diagrammatic drawings instead of one? Because on the hypothesis of mystification the medium in Maine would be fairly safe in choosing a square and a circle, as it is unlikely that *both* of these would be absent in *ten* diagrammatic designs.

Lest it be thought impertinent to criticise a sitting at which one was not present, it should be understood that only a few of those factors have been indicated which, instead of suggesting that the so-called cognition of unknown objects belongs to the "category of normal impossibilities" as Dr. Tillyard avers, point rather to normal interference from internal evidence alone.

With regard to the thumb prints, Dr. Tillyard has not yet even *begun* to prove that the prints obtained at the sitting are identical with those of Walter Stinson in life. Certainly *if* it could be proved that a print was found on the razor, *and* that it was made by Walter on the morning of his death, then there would be some reason for suggesting that certain features of the prints

made on wax resembled, or were identical with, certain features of Walter's thumb print made when alive. But this is all that can be said, and until we have seen an untouched photograph of the print alleged to have been found on the razor, it way be as well to suspend our judgment on the resemblances between it and the wax impressions.

Apart from this, however, even assuming that everything occurs exactly as related by Dr. Tillyard, it is not easy to understand what possible connexion the thumb print has with Walter's surviving personality. For, we can scarcely suppose, as Dr. Tillyard appears to do when he speaks of Walter's "surviving voice", that Walter's *body* has survived and is living in some other world. The thumb is, if we understand Dr. Tillyard's theory correctly, built up afresh at each sitting out of 'teleplasm' produced from the medium's body. Since, according to this hypothesis, we grant such staggering powers to the medium, what reason have we to deny her the additional power of producing out of teleplasm the thumb prints of anyone, living or dead? Assuredly few of us could, without detailed study, make a rough drawing of our thumb prints while we have our thumbs: what conceivable reason have we for supposing that we could make accurate reproductions when the flesh of our thumbs has long since crumbled to dust? The problem has no longer any basis from which speculation is possible. If these be facts, then they prove nothing beyond the very remarkable powers of Margery.

Returning from our flights of phantasy we may well ask why Dr. Tillyard preferred a stranger to accompany him to the sitting, whilst his associate, Mr. Evans, was left outside the door. Moreover, from Dr. Tillyard's account it is clear that 'Walter' and not he was in control. As before, they are not Dr. Tillyard's experiments: he is merely a spectator at one of "Nature's shows." We cannot help asking ourselves whether, if he had been the experimenter, and not "the respectful audience," the show would not have been more like Nature—natural. We believe that Dr. Tillyard will have to bring much more convincing evidence of the actual existence of Walter's spiritual personality than that presented by him in his article before it can pass the critical bar of science. The existence alone of a spiritual voice capable of producing compressional waves in air, having a characteristic quality and capable of being recorded and analysed by suitable instrumental means, requires so many physical assumptions that only by demonstration under the most precise conditions could such a spiritual means of producing sound be established. We suggest that any further inquiries should be concentrated upon this point. Once it is proved that a spirit can mould a larynx and mouth cavity out of ectoplasm, and can force air through them so as to make sound and speech by such means, it would be easy to accept most of the other supernormal phenomena to which Dr. Tillyard has given attention.

Private and State Forestry.

The position of private forestry in Great Britain was dealt with by Lord Clinton in an address delivered at the annual meeting of the Royal Scottish Arboricultural Society and published in a recent issue of the *Scottish Forestry Journal*. Lord Clinton pointed out that some 50,000 acres of woods had been felled during and immediately after the War, and that but a small proportion of this area had been replanted. "The causes," he said, "are quite easily seen. It is partly, but not wholly, owing to the War. It is mainly due to penal taxation during the War and later, which has made it impossible for many owners to replant their land. . . . It is very difficult indeed to get any exact estimate of this downhill progress, but we have estimates, for what they are worth, and it appears to us [the Forestry Commissioners] that there is being felled annually throughout the Kingdom a total of about 50 million cubic feet, representing perhaps 20,000 to 25,000 or even more acres, and we cannot ascertain that there is a larger area being planted than about 12,000 acres, obviously a quite insufficient replacement."

Lord Clinton anticipates that it is probable that the whole of the coniferous timber and almost the whole of the hardwoods (that is, broad-leaved species) now growing will have been felled by the end of the next seventy years. There has been little planting of hardwoods for a long time; many of the existing private woods have not been planted from the economic point of view, their *raison d'être* having been either sport, amenity, or protection; and the stocking therefore was in most cases very poor. If planting in one form or another is not carried on on a greater scale, by the end of seventy years there will be a smaller area of woodlands in Great Britain than the 3,000,000 acres present in 1914. On the Continent the State by no means owns the major part of the forested area, for example, Finland 43 per cent, Germany 25 per cent, and Sweden 20 per cent only. The remaining forests are either held in communal ownership or

belong to private persons; and both classes of owner receive certain assistance in remission of taxation and otherwise from the State, and have to obey certain laws and restrictions laid down on the subject of forest property.

Lord Clinton evidently does not think that forestry should be a purely State business in the future. Certainly the acts of the Forestry Commissioners themselves so far have given full cause for the belief—for they have been mainly confined to afforesting new land by planting conifers to the entire neglect of hardwoods. Moreover, but small progress has been made with the important work of replanting the areas felled during the War. These, it may be admitted, are in private ownership; but it should have been a first duty of a State forest department to devise some scheme under which these could have been reafforested at the earliest possible date in order to preserve the valuable forest soil which had been built up by the former crop of trees. For such areas will yield a higher return under good management than new lands which are now being afforested after a long period of degradation. On one point many will be in agreement with the present chairman of the Forestry Commissioners. It is stated fairly in the following: "I am not at all confident that the State can properly undertake the full duties of afforestation. I think the keenness of the general public—who in theory are very keen upon forestry—is likely to evaporate directly they begin to understand the great cost which will fall on them if the State shoulders the whole burden." This is a shrewd appreciation of the probable present position of public opinion in the matter, and would be endorsed by most forest officers who had had administrative experience in a properly organised forest service.

Television.

Practical Television. By E. T. Larner. Pp. 176 + 13 plates. (London: Ernest Benn, Ltd., 1928.) 10*s.* 6*d.* net.

WE welcome this work, which deals with the fundamental principles from which television is being developed. The reader will find it of interest, as sufficient scientific and mechanical details are given to satisfy his curiosity. We think that the young scientific worker will do well to study this latest branch of applied science, as it offers great possibilities. Some of us have seen the birth of telephony and watched the growth of a vast industry employing hundreds of thousands of skilled workers which has profoundly modified the conditions of modern life. In 1879 we remember Sir William Thomson getting one of his class to sing into a phonograph and the professor's efforts to make it reproduce the song. None of us imagined that the comic toy would develop into the gramophone as we now know it. Similarly, in watching the development of moving pictures and radio communication, few of us thought that they would so largely affect our everyday life. Television is the latest development of applied science. It will provide scope for research and development for years to come, but we feel certain that it will become part of our everyday life. Instead of merely listening to an expert describing the progress of a boat race or a football match, the younger generation may look forward actually to seeing them on a televisor as well.

Many years ago Prof. Ayrton made a remarkable prophecy; he said: "The day will come when we are all dead and forgotten and our electric cables have all rotted away. In these days a man who wishes to speak to a friend will call him with a world-embracing electric voice and his friend will reply, perhaps from the slopes of the Andes, perhaps from a ship in the midst of the ocean, or if there is no reply, he will know that his friend is dead." We are already within measurable distance of such an invention. Though the results now obtainable may be crude, they are decidedly promising and we can look forward with confidence to their improvement. In our opinion, therefore, those who belittle the work of inventors of television are not true friends to human progress.

The word television has now come into general use as a term describing the practically instantaneous transmission of the images of objects either by electric currents in wires or by radio waves. It must not be confused with the telegraphic transmission of photographs. This art is called phototelegraphy and has many commercial applications. If it were possible to transmit sixteen photographs per second, we could easily get kinematograph transmission, but this would not be television. In phototelegraphy a small picture takes about ten minutes to transmit.

As the action of the drum of the ear is imitated in a telephone, so in television the first steps were made by considering and copying the mechanism of the eye and utilising the phenomena associated with it, as, for example, the persistence of vision. The early inventors endeavoured to construct artificial telegraph eyes by substituting selenium for visual purple, and building, as the author says, an artificial retina out of a mosaic of selenium cells.

It was soon found out, however, that a drawback to the use of a selenium cell in television work was its time lag. After exposure to illumination it only recovers its resistance slowly.

The photo-electric cell which has been perfected by high vacua research has superseded the selenium cell. This cell is capable of detecting the light of a candle at a distance of two miles and responds to the flashing of light on it for the millionth of a second.

Promising attempts have been made by Belin, Dauvillier, and Campbell Swinton to devise television apparatus by utilising cathode rays. So far back as June 18, 1908, Campbell Swinton suggested this method in a letter to NATURE. In 1923 J. L. Baird in Great Britain and also C. F. Jenkins in America demonstrated the electric transmission of shadowgraphs. In 1926 the former gave the first demonstration of true television, real images being shown on a screen by diffusely reflected light. Since then he has made several remarkable advances. The American Telephone and Telegraph Company gave a successful demonstration of television in May 1927. Early last year also, Dr. Alexanderson described his system to the American Institute of Electrical Engineers.

The principle adopted by Baird in his televisor is one used by other inventors, the image reproduced being made up in parallel lines. The light proceeding from a brilliant source is reflected from the picture surface and focused on to a light-sensitive cell. The finely drawn lines of light are swept across the picture. The varying gradations of light and shade cause a varying electric current to be given out by the cell. These variations of current are thrown into the ether and, falling on the receiving set, control the light from a lamp placed behind an arrangement of revolving discs similar to an arrangement of revolving discs at the transmitting end.

One of the difficulties that had to be overcome was to make the two revolving systems rotate in exact synchronism with each other. Baird used two motor generators, each consisting of a direct current motor coupled to a 500-frequency generator. The waves due to the alternator and the fluctuating current from the light-sensitive cell fall on the receiving end where the two currents are filtered out. The alternating current after amplification is used to control the speed of the receiving alternating current machine.

A modification of this device was used by the American Telephone and Telegraph Company in recent experiments. Instead of using a d.c. motor to give the drive, a low frequency a.c. motor was used. This has the advantage of making it easier to get the two machines to work in step, but it has the serious disadvantage of requiring another synchronising wave-length. A very promising device has recently been invented by Marrison and Horton in the United States. They use quartz crystal oscillators, which they claim are capable of holding the rate of vibration constant to within one part in ten million. It is stated that, using this method, the image will not wander more than one-third of its width per hour and that it can be very easily held in place.

Baird's most recent success was to transmit on Feb. 8 images from his television laboratory in Long Acre to Hartsdale, a suburb of New York. The radio part of the transmission was from a transmitter at Purley to Hartsdale. Naturally, the images were crude and broken, but two of the three faces which appeared in succession on the screen were clearly recognisable. Transatlantic transmission is thus possible. It will be remembered that nearly thirty years ago Marconi and Vyvyan sent mutilated signals across the Atlantic. The success of this achievement is still doubted by some.

The photo-electric cell is sensitive to a much wider range of wave-lengths than the eye. By making use of this fact and using the invisible infra-red rays, Baird has demonstrated that vision is possible in total darkness. Persons sitting in what appears to be total darkness can be seen quite plainly at any distance away in a modified form of television apparatus called a 'noctovisor.' The colours of the images are wrong: red appears as white and blue appears as black. A further peculiar effect is that smoke is semi-transparent. The fog-penetrative powers of the infra-red waves are no new discovery. In aerodromes, neon tubes with their deep red glow are used to guide the airmen, as this light has great fog-penetrative powers. It looks as if the noctovisor would increase the range of vision through fog.

Baird has also shown how it is possible to 'can' an image by means of a phonograph and reproduce it at any subsequent time. He calls his device a 'phonovisor.' Before these various devices are perfected, there are many serious difficulties to be overcome, but physical science has made immense progress during the last ten years and its tools have been perfected in an almost incredible way. We agree with the author of this excellent book that television will give us electrical vision that will ultimately extend all round the earth.

Since writing the above review we have seen Baird's method of producing colour television.

The process consists of first exploring the object, the image of which is to be transmitted, with a spot of red light, next with a spot of green light, and finally with a spot of blue light. At the receiving station a similar process is employed, red, blue, and green images being presented in rapid succession to the eye.

The mechanism used at the transmitter consists of a disc perforated with three successive spiral curves of holes. The holes in the first spiral are covered with red filters, in the second with green filters, and in the third with blue. Light is projected through these holes, and an image of the moving holes is projected on to the object. The disc revolves at ten revolutions per second, and so thirty complete images are transmitted every second—ten blue, ten red, and ten green.

At the receiving station a similar disc revolves synchronously with the transmitting disc, and behind this disc, in line with the eye of the observer, are two glow discharge lamps. One of these lamps is a neon tube and the other a tube containing mercury vapour and helium. By means of a commutator the mercury vapour and helium tube is placed in circuit for two-thirds of a revolution and the neon tube for the remaining third. The red light from the neon tube is accentuated by placing red filters over the view-holes for the red image. Similarly, the view-holes corresponding to the blue and green images are covered by suitable filters. The blue and green lights both come from the mercury helium tube, which emits rays rich in both colours.

The coloured images we saw which were obtained in this way were quite vivid. Delphiniums and carnations appeared in their natural colours, and a basket of strawberries showed the red fruit very clearly.

A. R.

Biography in American Science.

American Men of Science: a Biographical Directory. Edited by J. McKeen Cattell and Jacques Cattell. Fourth edition. Pp. viii + 1132. (New York: The Science Press, 1927.) 10 dollars net.

THE fourth edition of this great work—great in two senses of the word—must not pass unnoticed in NATURE, and we congratulate the editors on the completion of their heavy task of revision. The number of individuals dealt with is about 13,500, which may be taken to be an approximately close measure of the number of professional men of science in America. We say, advisedly, professional men of science, for of the first 'starred' 601 only a single individual is described as an 'amateur.' Roughly, 60 per cent of the leading American men of science are engaged in teaching, 16 per cent in research institutions, 12 per cent in government employ, 10 per cent in applied science, and 0·2 per cent is due to the single amateur. The remainder, 1·7 per cent, is accounted for by deaths.

Men of wealth in America employ their means, occasionally curiously, often most advantageously, in the establishment of universities and special research laboratories, but the number of men, even of moderate means, who spend them on their own scientific researches seems surprisingly small; at any rate in America such men fail to reach high distinction. Probably the 'amateur,' to whom we in Europe owe so much, is also becoming less frequent here, but we venture to think such a result is lamentable. A rapid scrutiny of the present list of Fellows of the Royal Society will scarcely produce more than the names of four men who may be rightly termed amateurs, that is, who have devoted much of their time to scientific work, without holding paid scientific posts. Of course, we do not use the term 'amateur' to denote that they have been without scientific training. Whether the work of those four men will rank with that of Darwin, Rayleigh, Galton, Huggins, Spottiswoode, Grove, etc., posterity alone can say. But it is fairly obvious that he who gives his life as well as his wealth to scientific work is a national asset, and may, if he be a man of leisure, achieve greater things than the professional man of science, who often has to give up too much of his time to teaching and executive duties. It is simply appalling to note the amount of time spent (largely unprofitably) in council, faculty, boards, and committee meetings in some modern universities!

To discover connotes having leisure to think, and accordingly not a small element of scientific research to-day is done almost as a routine task, without the investigator sitting down to *think.* Quantity, rather than quality, of publication, choice of popular topics for research, the being always 'on tap' to the newspaper man, are factors which determine in not a few cases the success of the professional man of science. The young man at the university is too apt, if he has done moderately well, to take up science as a livelihood, for it requires less of post-graduate professional training than many other callings. His choice arises not from pure devotion to science, but from the need for an immediate living; this is un-

doubtedly the factor which draws many young men and women into academic science to-day. Like not a few ministers of other faiths, they have not fully thought out their suitability to a high calling. Probably much the same statement is true of America. There has been not only a great increase in the number of colleges and universities, but also a still more rapid rate of increase in the number of undergraduate students. This has involved in both countries a very great rise in the number of subordinate scientific posts. Within the last quarter of a century in some universities these subordinate posts have increased by nearly two hundred per cent, and now stand at nearly five times the numbers of the professorial posts. While a few of these subordinate posts are just sufficiently well paid to enable a man to spend with rigid economy the working period of his life in them, the great bulk are not so, and, subordinate posts being so much more numerous than the professorial, it is only the exceptional few who can hope to rise to even those—often badly paid—first-rank positions. The general result is that the increased desire for university training has rapidly produced a class of subordinate teachers with little or no prospect in life, thoroughly discontented with their position, and incapable of doing in such circumstances the best scientific work.

It would have been of great interest if Dr. Cattell had felt able to carry his useful statistical analysis of American men of science somewhat further. The edition of 1910 contains about 5,500 names; that of 1927, 13,500; how has this increase been distributed? Have the subordinate posts been multiplying far more rapidly than the professorial, so that promotion can only be for the favoured few? Is it true that in America these subordinate posts are relatively as badly paid as in Great Britain? We cannot assert it, but we have heard rumours that would make matters as bad for the junior academic teachers in America as in Great Britain. It is therefore with a slight feeling of depression that we note these 13,500 biographies! Are we really facing a great army corps of enthusiastic and militant men of science, or only a list of those who in the bulk have engaged in the scientific profession as a source of livelihood? Dr. Cattell has provided a means whereby to some extent we can pick the approved grain from the chaff. He has endeavoured to select the 1000 leading American men of science, by a system in which specialist groups vote for the most distinguished of their colleagues. The system seems somewhat invidious, as the older men, chiefly the voters, are not unlikely to vote for each other, or to overlook novel lines of research opened up by the younger. Still, the present writer has done his best to test the efficiency of the 'starring' system, as far as it falls within his own knowledge. In recent years a number of young English chemists have gone to America; quite a number of these have already acquired the asterisk. Further in the course of his career having had a considerable number of American students, he was able to satisfy himself that the most able were also starred. Of course the star did not fail those American men of science whose names are as familiar here as those of our own leaders.

When, however, we have thus reduced our chief American men of science to the thousand starred, it is very difficult to get a grip on them! How are we to find out this select thousand scattered over 1100 unindexed pages? Let us suppose that a geneticist who has written what he holds to be an important paper on heredity in the skull shape of rats, wishes to communicate his results to his colleagues in America. He cannot look through the 1100 pages to find the zoologists with a star who are interested in genetics. Or, again, a bookseller who wishes to send his catalogue of rare mathematical books to those interested in the history of the subject, how can he rapidly find his clientele in this bewildering 13,500 distributed over 1100 pages? If the name of a man be known he can be looked up at once, but it is not possible rapidly to find those interested in a particular topic. Now on pp. 1103-9 we have the names of those who have died since the last issue, between 600 and 700 names, occupying about six pages. We venture to suggest that in the next edition of "American Men of Science" the 1000 selected men be given on about ten pages; their names to be arranged alphabetically under their broad categories, for example, mathematics, agriculture, palæontology, psychology, etc.; each surname to be followed by the initials of the christian names only, and one or two words denoting the branch of the broad category especially studied. Thus:

CHEMISTRY.

Rieman, W., *Emulsions*.
Chamberlain, J. S., *Agricultural*.

BOTANY.

Hottes, C. F., *Physiological*.
Houghton, A. D., *Genetics*.

These are only illustrations selected at random, and in the case of the selected 1000 they might be allowed to choose their own subheading, con-

fined, if feasible, to a single word. We feel sure this would increase the usefulness of the work and much aid the advantageous distribution of off-prints.

One of the general conclusions we may draw from the mere turning over of the pages of this volume is of extraordinary interest to the inhabitant of Great Britain. There occur foreign names, German, Slavonic, Italian, etc., indicating continental European extraction; but the vast majority of these American men of science bear familiar Anglo-Saxon surnames, which suggest that our race at the very least is making in the New World its full contribution to the scientific profession.

We congratulate the editors on the catholicity of this great work in its fourth edition, and if we have ventured to suggest a few additional pages to the next issue, it is because we believe they would add greatly to the usefulness, and with that to the sale of the work. We wish a like directory might be done as effectively for British men of science.

Deep Shafts and their Construction.

Vertical Shaft Sinking. By Edward Otto Forster Brown. (Benn's Mining Series.) Pp. 432. (London: Ernest Benn, Ltd., 1927.) *52s. 6d.* net.

THE sinking of deep shafts is a branch of mining of such an occasional nature that it is unusual to find anyone having experience of more than a few sinkings in one or two localities, or of the continued application of one and the same system in several fields, so that a specialist in this subject is not easy to find. In addition, it would be difficult to find a less attractive side of mining, or one more arduous, difficult, and troublesome; but it can also be very interesting, testing as it does the technical ability, tenacity, and ingenuity of the engineer in charge in the highest degree.

At one time probably the greatest amount of knowledge of sinking was possessed by sinking contractors of great experience, to whom the management concerned would pass on responsibility for the sinking of a pair of shafts, supervising only to see that the contractor carried out the terms of his contract. Whilst the contractor is still useful for places where the difficulties are likely to be great, his place has largely been taken by companies employing specialists in the particular method they use, who are capable of carrying out work well beyond the reach of an ordinary contractor. It will be found that much information formerly in the possession of the contractor and of the specialist only, is included in this book.

It is divided into four parts. Part I. consists of two chapters, Chapter i. being introductory, and Chapter ii. a most complete account of the sinking of a large deep modern shaft, of circular form, in firm ground such as offers little difficulty. In this part, the sinking of a large rectangular shaft might have been included, though, as might be expected, rectangular shafts are referred to further on in the book, in the chapter on shaft linings. Considering the importance of shafts of this form, and how common they are outside Britain, the inclusion of one or two important examples from abroad, even were they dealt with second hand, would have enhanced the value of the work. Another important matter not referred to in this part is the disposal of the debris from the sinking. It may be argued that this is not a problem of any great magnitude, but if it is considered that most of the unsightly pit-heaps in the country had their origin in the careless dumping of the debris from the sinking, the desirability of using this material to level up the surface near the shafts is obvious.

On p. 57 a formula is given for the calculation of the sizes of sinking engines. It is a simple equation of moments, which appears to be true, and its apparent soundness is supported by the statement that one cylinder must be capable of starting up against the maximum possible load. Since it does not include the effects of friction and inertia, it is conceivable that it could fail. In the example which follows the author clearly had in mind that something greater than was given by the formula would be necessary in actual practice, a view that would be adopted by all experienced mining engineers without doubt; but because this book is likely to be much consulted by students generally, slight revision appears to be desirable.

Part II. deals with the special methods of shaft sinking. There are three chapters of which the first, or Chapter iii., consists of descriptions of drop shafts, caisson sinking, and piling. These methods are common to the work of the civil and mining engineer, and are confined to comparatively shallow depths. This is followed by a chapter on cementation and another on freezing. The systems of magnified boring, which were once such a feature in text-books on mining, are not included; their places have been taken by cementation and freezing, both in this book and in practice.

It simplifies the view of the difficulties which called these special methods of shaft sinking into being to say that water is the great enemy to safe, speedy, and successful sinking, as it converts ground which might otherwise be easy to deal with into difficult and sometimes treacherous ground. When in addition the water is acid, and therefore corrosive to the metal structures used as temporary or as permanent lining, the added difficulty and danger can be very great, and lead, as it did at Methley, to a frightful disaster.

Though they may not contemplate using the special methods, many mining engineers will read this section of the work with interest, probably more particularly the chapter on cementation. The use of cement in construction and repair work is assuming great proportions, and a detailed account of its use in sinking shows that mining engineers are not slow to take full advantage of anything useful, but the plan of the book, excellent as it is, interrupts the account of the use of cement, in that a most important part of it is found in a later chapter on shaft lining. In this case and in freezing, the lining is so much a part of the method that it spoils the exposition to separate them; though it is admitted that this view may not be shared by every one. The matter in Part II. is probably the most comprehensive contribution to literature on special methods of sinking added during the last twenty years or more.

Part III. is devoted to special departments of shaft sinking. In reality, however, it will be found that all sorts of matters are here taken up which require more detailed treatment, or which require addition of relevant matter. For example, Chapter vi. takes up excavation again, and gives a detailed account of compressed air drills, drilling, and blasting; and Chapter vii. is allotted entirely to shaft lining, a subject already discussed in an elementary way in Chapter ii. Hoisting in sinkings and everything connected therewith is dealt with in Chapter viii., and the succeeding Chapter deals with all sides of the dewatering of sinking shafts. The same attention to detail is to be found in Chapter x., which is on ventilation, lighting, and labour, but it would seem that part of the material of this chapter really belongs to Part IV. It is probable that Part III. will be used largely for reference on account of the large amount of detail given.

The economics of sinking is to be found in the single chapter which forms Part IV., a portion of immediate interest to all those mining engineers having shafts in the course of sinking, or contemplating the sinking of shafts. The appendices giving the different forms of sinking contract may be very useful.

By way of summary, it may be said that the book is a valuable addition to the literature of practical mining. The dimensioned line drawings will be especially useful to mining engineers in Great Britain and elsewhere, and also to teachers and students, whilst the inclusion of twenty-four tables of comparative matter is not the least useful feature of the book. As might be expected, the author has held to the view of the mining engineer engaged mainly in coal mining, and, as the title suggests, he does not deal with inclined shafts or with those shafts which are partly vertical and partly inclined, of which large numbers are to be found in metalliferous mining, so that the book is not exhaustive. It will, however, remain as a standard work on this branch of mining for some time.

C. HABBERJAM.

Our Bookshelf.

The Lindley Library: Catalogue of Books, Pamphlets, Manuscripts and Drawings. Pp. viii + 488. (London: Royal Horticultural Society, 1927.) To Fellows, 17*s*. 6*d*.; to Non-Fellows, 21*s*.

THE former edition of this catalogue, which was published in 1898, was scarcely more than a pamphlet. In the edition before us we have a volume of nearly 500 pages crowded with the titles, usually as brief as possible, of the books, pamphlets, manuscripts, and drawings—altogether about 12,000—comprised in the Lindley Library, which is controlled by a body of trustees for the benefit of the fellows of the Royal Horticultural Society and others, and is at present housed in the Society's hall in Vincent Square, Westminster. The Society now includes upwards of 25,000 fellows, whose privileges include access to this rich collection of literature at all times when the library is open, and the borrowing of books from it under certain restrictions.

While presumably some interest in horticulture influences so many to obtain fellowship of the Royal Horticultural Society, the trustees of the Lindley Library have provided much more for the fellows of the Society than the horticultural works which are now being produced in such bewildering profusion. Literature on practically every branch of botany is included in it. We notice a fair number of sixteenth-century herbals, amongst them "The Grete Herball" of 1526. Of the rarer or more costly works there are Sibthorp's "Flora Græca," Redouté's "Les Liliacées" and "Les Roses," A. P. de Candolle's "Plantarum succulentarum historia," Mary Lawrance's "Collection of Roses from Nature," Siebold and Zuccarini's "Flora Japonica," Roxburgh's "Plants of the Coromandel Coast," several of N. J. Jacquin's

illustrated folios, the six volumes of J. D. Hooker's "Botany of the Antarctic Voyage," Sargent's "Silva of North America," and Elwes and Henry's "Trees of Great Britain and Ireland." Most of the standard British colonial and Indian floras, such as Bentham's "Flora Australiensis" and Hooker's "Flora of British India," are available in the library, while European local floras are well represented.

The more important botanical periodicals noticed in the Catalogue are the *Annales des Sciences Naturelles (Botanique)*, *Annals of Botany*, Engler's *Botanische Jahrbücher*, Just's *Botanischer Jahresbericht*, *Botanische Zeitung*, *Flora*, and the *Botanical Magazine*, while the publications of societies, academies, and institutions, which have some bearing on botany or horticulture, are very numerous. It will be seen that in the Lindley Library there is much to attract the attention of horticultural and botanical students who will welcome the useful guide to its contents which the Catalogue affords.

Comparative Ethnographical Studies. By Erland Nordenskiöld. Vol. 7, Part 1: Picture-Writings and other Documents. By Néle, Paramount Chief of the Cuna Indians, and Ruben Pérez Kantule. Pp. iv + 94. (London: Oxford University Press, 1928.) 5*s*. net.

IN the present and succeeding volumes of his Comparative Ethnographical Studies, Baron Nordenskiöld is dealing with the results of his journey to Panama and Columbia in 1927. The investigations which he then carried out, as will have been apparent from preliminary and semi-popular accounts which have been published already, are likely to prove of singular interest to ethnography. This, the first, instalment deals with documents produced in part by a paramount chief of the Cuna Indians, in part by an educated Cuna Indian, who can both speak and write Spanish. The material consists for the most part of magical texts for the healing of disease, the majority in Cuna with Spanish translation, and a "Historia" in Spanish.

Baron Nordenskiöld supplies some introductory notes on the authors and on the magical and religious ideas of the Cuna. These are intended merely to elucidate the text pending more exhaustive treatment in a later study. Valuable as is this record by actual exponents of the magic art, its interest is surpassed by the picture writing, which the editor thinks probably represents or is descended from a system of writing to which reference was made by Martyr in the sixteenth century.

Radiation in Chemistry. By Dr. R. Alan Morton. (Industrial Chemistry Series.) Pp. xv + 284. (London: Baillière, Tindall and Cox, 1928.) 15*s*. net.

THIS volume must be regarded as consisting chiefly of a digest of a well-known book on the chemical effects of ultra-violet light, of the recent symposium held by the Faraday Society, of photochemical action and of the work on carbon dioxide assimilation carried out by Prof. E. C. C. Baly at Liverpool.

It contains a number of interesting technical points in connexion with light sources and their manipulation, with a great number of isolated observations on photochemical action each one not without interest; the chapters on the photographic plate and on the action of light on biochemical changes may be cited as excellent in this respect. From this point of view the book is not only interesting but also stimulating. On the other hand, the theoretical portions are not only slender but are also far from complete, and it is to be hoped that if ever a second edition is called for the opportunity of providing a really valuable monograph will not be lost. The book is well arranged and the printing good. ERIC K. RIDEAL.

From the Monotremes to the Madonna: a Study of the Breast in Culture and Religion. By Fabius Zachary Snoop. Pp. vi + 143. (London: John Bale, Sons and Danielsson, Ltd., 1928.) 3*s*. net.

WE would commend this little book to lovers of bypaths in folklore. In this case the bypath leads to a highway, for, as the erudite author shows, the ideas which gather round the breast in popular belief, in art, and literature, lead ultimately to the fundamentals of religious belief and human behaviour. The author has drawn many interesting data from a variety of sources, but it is in his more general conclusions that his book is most suggestive. Not the least interesting of these is his view, tentatively expressed, that in the different attitude of man and woman towards certain conceptions in which sexual and secondary sexual characters are involved, may lie the cause of religious oppositions such as that between Roman Catholic and Protestant, and that these may therefore ultimately be incapable of adjustment.

The Structure and Properties of Matter. By Dr. W. A. Caspari. (Benn's Sixpenny Library, No. 143.) Pp. 78. (London: Ernest Benn, Ltd., 1928.) 6*d*.

DR. CASPARI'S modest little work is one which may be recommended to all interested in science. It contains a surprising amount of information in a small compass and is written in a very readable way. Only an author with a complete mastery of his subject, and fully abreast of the recent advances in research, could have written this book, but Dr. Caspari has added to this competence a real ability to tell his story in a most interesting way.

Qualitative Analysis. By Dr. W. Wardlaw and F. W. Pinkard. Pp. vii + 166. (London: Longmans, Green and Co., Ltd., 1928.) 3*s*. 6*d*.

THIS book is sufficiently detailed to serve the requirements of students preparing for the intermediate and final degree examinations and for higher school certificate examinations. It is accurate and is clearly written, and a good feature is the concise explanation of the theory of the methods used. Practical difficulties are dealt with as they arise. The separations are those which have proved satisfactory for a number of years and are generally taught in Great Britain.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Photographic Enlargement of Small Solid Objects and the Limitation of Definition obtainable on Gelatine Plates.

THE chief difficulty met with in taking enlarged photographs of small solid objects is, that unless the thickness of the object is small compared to the focal length of the lens, only a small part or zone appears in good focus at the same time.

The limit of attainable definition in terms of the thickness of the object and the focal length and diameter of the lens can be expressed very simply. Let D be the diameter and f_1, f_2 the conjugate foci of the lens; then if the thickness of the object is $2e$, a point at $f_1 + e$ will (so far as geometrical optics are concerned) be represented on the focal plane through f_1 by a circle of confusion the diameter of which $\Delta_1 = eD/f_1$, or if $e = f_1/n$ by D/n. Also if the magnification (namely, f_2/f_1) is m, the circle of confusion on the focal plane through f_2 is

The image of a bright point, however, even if formed by a perfect lens, is itself a circular disc the diameter of which is of the order $f\lambda/D$, λ being the wave-length of the light employed. The best definition, therefore, of an object $2e$ thick is attained when $\lambda/D = D/n = \Delta/f$, or, in words, when the circle of confusion dependent on parts of the object being out of focus has the same diameter as that of the 'spurious disc,' as $f\lambda/D$ is often called when referring to star images.

This may be illustrated by an example. Suppose it is desired to form an image of an object a tenth of an inch thick covered with dots a thousandth of an inch apart, and that all these dots are to appear separate in the image. In the present case, since $e = 0{\cdot}05$ inches and $\Delta = 0{\cdot}001$ $D/f = 1/50$, so that the stop to be used is $f/50$. Also since e, λ, and D are the only linear constants in the problem, the ratio $f_1/e (= n)$ may be chosen at will provided that n is a large number. Assume that $n = 100$, then $f_1 = 5$ inches and $D = \frac{1}{10}$ inch. If it is desired that dots a thousandth of an inch apart should be easily distinguished by the unaided eye, the magnification should not be less than 20 diameters. Thus with $f_1 = 5$ inches, f_2 should not be less than 100 inches.

A camera eight or nine feet long is not a convenient form of apparatus: but were it practicable to make the enlargement in two stages, first taking a photograph of the natural size or thereabouts, and afterwards enlarging this picture (in which the thickness of the object does not count) lenses of ordinary focal length might be used. If the first picture were taken on a collodion plate or film, this method would be possible, but not with any form of gelatine-emulsion, because, so far as my experience goes, clear and separate dots or marks cannot be produced on such plates either by contact printing or in the camera when the distance between them is much less than 1/150 inch. With collodion plates, on the other hand, there is no difficulty in getting well-defined lines separated by 1/4000 inch or less.

In order to find out whether the expression $f\lambda/D$ gave a reasonably correct value for the diameter of the 'spurious disc,' trials were made with several photographic and other lenses, by focussing the image of an 'artificial star' in a microscope and measuring the diameter of the disc with an eyepiece micrometer. The star was the virtual image of the sun in a small mercury bulb and, as seen from the lens, subtended an angle of about $\frac{2}{3}$ of a second of arc—quite small enough to be taken as a print in connexion with lenses of the diameter used in these trials.

The results are given in the Table below.

From these results it appears that so long as f/D is large, the expression $f\lambda/D$ does approximately represent the diameter of the 'spurious disc,' but it must be noted that the disc itself is not sharply defined, but shades off gradually towards the boundary, so that the micrometric measurement is rather uncertain.

TABLE.

OBSERVATION ON THE IMAGE OF AN ARTIFICIAL STAR.

Lens.	Focal Length f_1.	Diameter D.	Stop No. f/D.	Diameter of Image by Geometrical Optics.	Diameter of Image by Micrometer Measurement.	Diameter of Image by $f\lambda/D$.
Telescope (Troughton and Simms)	13	1·8	15·5	$\frac{1}{15000}$	$\frac{1}{2500}$	$\frac{1}{3200}$
Telescope from (Subcycle lens)	15	1·6	9·7	$\frac{1}{20000}$	$\frac{1}{3000}$	$\frac{1}{5250}$
Achromatic lens (maker not known)	2·5	2·0	3·8	$\frac{1}{40000}$	$\frac{1}{4200}$	$\frac{1}{13000}$
Anastigmat (Beck and Steinhill)	6·8	0·85	8	$\frac{1}{11000}$	$\frac{1}{2200}$	$\frac{1}{6250}$
Anastigmat (Beck and Steinhill)	6·8	0·27	26	$\frac{1}{44000}$	$\frac{1}{1050}$	$\frac{1}{1950}$
Concentric (Ross)	4·3	0·27	16	$\frac{1}{70000}$	$\frac{1}{3000}$	$\frac{1}{3150}$

With a perfect lens, the image of a bright point should appear as a bright circular patch surrounded by bright rings the intensities of which decrease rapidly with their order, and with a good lens not more than three should be visible. The number and intensity of the rings surrounding the central disc form a good test for spherical aberration (see NATURE, Oct. 8, 1891, p. 552).

When the image of the 'star' was photographed on gelatine plates, the diameter of the patch developed was anything from ten to several hundred times that of discs as measured by the micrometer, the rings being completely obscured. This spreading of the developed part of the film about a bright centre seems inseparable from gelatine emulsion, and indeed it is this property which renders possible the cheap reproduction of illustrations in newspapers. Whether the spreading is due to the direct action of light, or, in part, to some sort of contagion such as Abney found to occur in gelatine-bichromate films, I do not know.

I have tried many experiments, such as leaving exposed and unexposed films in contact under pressure, but have not been able to detect any sign of mutual interaction, though it seems not impossible that some action of the kind may take place in the closer contact between adjacent particles of bromide in the same film.

The great size of the developed patch compared to that of the 'spurious disc' should be borne in mind when attempting to determine the position of a star from photographs or gelatine plates. A somewhat parallel case would be to attempt to determine the centre of a blank target six feet across to within half an inch, by taking the mean position of a group of shots fired at six hundred yards. The result might be right by accident, but it would show want of judgment to found any conclusion on it which depended on, or assumed an accuracy of, the order referred to.

A. MALLOCK.

9 Baring Crescent,
Exeter, July 7.

Laboratory Uses of Monel Metal.

MONEL metal is an alloy containing approximately 67 per cent nickel, 28 per cent copper, and 5 per cent other metals, which is made from a natural ore mined in Ontario, Canada. It is of great utility in cases where resistance to corrosion is important. Its chief properties and commercial uses are described in a booklet issued by G. and J. Weir, Ltd., Cathcart, Glasgow. Now, although monel metal is a well-known article of commerce, it does not appear to have found particular application in physical laboratories, and the object of this letter is to direct attention to its possibilities in this connexion.

In the first place, monel metal is ferromagnetic and possesses such a low magnetic critical temperature that it may conveniently be used for a laboratory experiment to illustrate the loss of ferromagnetism with rise in temperature. The magnetic critical temperature varies from specimen to specimen, and is stated to lie between 100° and 150° C. This appears to apply to specimens in the form of the stout bars supplied commercially, but specimens in the form of anchor rings of diameter 10 cm. and 1 cm. thickness supplied to us possess critical temperatures of 70° C. The induction of such an anchor ring may be measured by the ballistic method at different temperatures, the ring being immersed in a bath of B.P. paraffin, and good results are obtained if the magnetising current is not allowed to heat the specimen. The student must possess a certain amount of skill in order to obtain a satisfactory hysteresis curve by the ballistic method, as the temperature of the specimen must be kept constant. The retentivity of our anchor ring specimens was 670, and the coercive force 1·8 gauss.

Monel metal is also very satisfactory in the following experiment. The weight of a drop of liquid falling from the lower side of a horizontal flat circular tip may be represented by the equation $m = KrT$, where m is the weight of the drop, r is radius of the tip, and T is the surface tension of the liquid. It is well known that K is not a constant for any given liquid, but varies with r. The variation of K with r for a given liquid may be investigated by using tips of different radii. This was done by Rayleigh and others, and very carefully by Harkins and Brown (*Jour. Amer. Chem. Soc.*, vol. 41, p. 499; 1919), who used a series of brass tips and one tip of monel metal. The experiment forms an excellent demonstration of the fact, very often not made clear in text-books, that the shapes of drops hanging from tips of different radii are widely different.

Tips of monel metal can be prepared without much trouble, whereas glass tips require great care in grinding, and other metals suffer corrosion. A useful series of tips consists of seven with the following radii: 0·94, 0·87, 0·75, 0·60, 0·45, 0·30, and 0·13 cm. The hole in the middle of the horizontal face may conveniently be of 1 mm. diameter. As water does not wet polished monel metal, the surface must be suitably roughened. Harkins and Brown ground their metal tips with medium carbonundum powder, but the monel metal surface may be very rapidly prepared by immersing it for a few seconds in concentrated nitric acid, washing it in water for a few minutes, and then placing it in chromic acid, which attacks it slowly. The surface is then free of grease, and the liquid to be investigated should spread over the face of the tip but not upon its sides. The liquid is fed into the tip at such a rate that drops are not formed more quickly than about one in two minutes. It should be possible to level the tip, for its lower face must be accurately horizontal, particularly if the tip is large. Precautions should be taken against evaporation and the drops should be collected in a weighing bottle. The smooth curve reproduced here (Fig. 1) was obtained with water; for comparison, the results of Harkins and Brown are also reproduced by the broken curve, the point common to both curves being obtained with their monel metal tip. Different liquids, of course, give curves of different shapes.

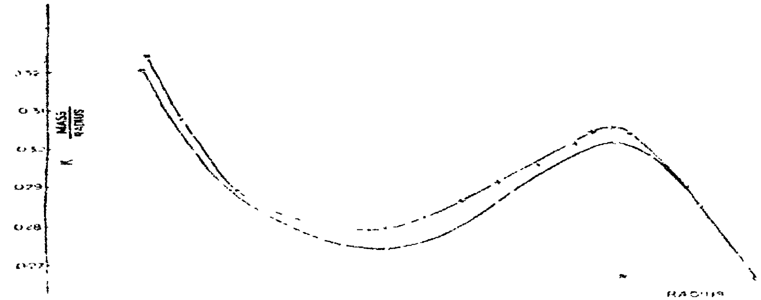

FIG. 1.

Monel metal may further be used in making jets for the determination of surface tension by Jaeger's method. It is particularly useful with mercury and molten metals which do not amalgamate with it. If glass is used, one is usually forced to rely upon a happy fracture in obtaining a satisfactory jet, but monel metal may be drilled and turned to any dimensions with precision. After a few bubbles have been released, the pressure required to release a bubble becomes quite constant in the case of mercury at air temperature, a value of 477 dynes per cm. being obtained for the surface tension, assuming that the bubble is formed on the outer edge of the jet. This value agrees well with that obtained by other observers using the same method. Moreover, it is possible with a monel metal jet to investigate the behaviour of the surface tension with temperature up to the boiling-point of the mercury.

L. F. BATES.
R. C. BROWN.

University College,
London.

The Occurrence of the American Oyster Pest *Urosalpinx cinerea* (Say) on English Oyster Beds.

IN NATURE of Nov. 5, 1927, one of us (J. H. O.) described experiments on the rate at which that rough whelk-tingle, which is abundant on the oyster beds in the River Blackwater, devoured young oysters. In continuing these experiments, it was suddenly realised that the whelk-tingle from this locality is undoubtedly not, as stated (loc. cit.), *Ocinebra erinacea* (= *Murex erinaceus*, L.), although it is a closely related form. It was, moreover, found impossible to identify it with any form described in literature on, or present in a representative collection of, British shells. When it was established with certainty that this common Blackwater shell is not a British form, Winckworth was soon able to identify it from radula and shell-characters as *Urosalpinx cinerea* (Say), the American oyster pest.

Therefore in the note in NATURE referred to above, the name *Urosalpinx cinerea* (Say) must be substituted everywhere for *Ocinebra erinacea* and Urosalpinx for Murex, except for the designation of the right-hand shell in Fig. 1, p. 654. *Urosalpinx cinerea* is a close ally of *Ocinebra erinacea* and lays egg-capsules very similar to those of the latter; moreover, the egg-capsules of both species turn purple when the embryos they contain are damaged. In the near future it is hoped to review all the forms which cause destruction of oysters on different English oyster beds. It has, however, been proved that *Ocinebra erinacea* from the Fal Estuary destroys oysters, but that it is probably not so voracious as *Urosalpinx cinerea*, and more readily feeds on barnacles in the absence of oysters.

There can be no doubt that Urosalpinx has been introduced into English waters from America on American oysters in the same way, and probably about the same time, as *Crepidula fornicata* (see Orton, *Proc. Roy. Soc.*, vol. 91, B, 1909). This species of Crepidula is extremely abundant in the same locality (that is, in the Blackwater River) as that in which the Urosalpinx now occurs also abundantly. It would seem that both Crepidula and Urosalpinx (and possibly other organisms) at once found congenial conditions of food and climate on introduction into the rich Essex oyster beds and rapidly established themselves. The embryos or adults of Urosalpinx will certainly have been carried already to the Whitstable and other beds in the Thames Estuary either on American or native relaid oysters, and may have spread even to more distant beds. As Urosalpinx is a much more dangerous enemy to the oyster-producer than is Crepidula, additional precautions will be necessary to prevent the introduction of foreign pests from the Thames Estuary oyster beds to other parts of the country.

It is now possible to review the economic conditions on the Essex oyster beds in a new light. In the note to NATURE (*loc. cit.*) it was recorded that in 1924 50 per cent. of an experimental spatfall was destroyed by what we now know is Urosalpinx, and that a similar amount of destruction occurred over the whole of the neighbouring beds at the same time. During the last twenty or thirty years, or possibly less, Urosalpinx has become an effective addition to the enemies of the oyster-cultivator, and must have increased the difficulties in rearing brood oysters, compared, say, with the conditions which existed thirty or forty years ago. It is hoped that local inquiries may reveal more information regarding the time of arrival and spread of Urosalpinx and its effects on oyster-culture.

J. H. ORTON.
R. WINCKWORTH.

Plymouth and London.
July 31.

The Afterglow in Mixtures of Nitrogen and Oxygen.

IN a paper published by J. Kaplan in the *Proc. Nat. Acad. of Science* (**14**, 258; 1928) there are described some experiments on the afterglow accompanying the passage of an electric discharge through air at about 5 mm. pressure. A point of interest is the observation of a blue glow when a condensed discharge with spark gap was employed, but a yellowish-green glow when the spark gap was not in operation. In this connexion I wish to mention a phenomenon which I observed some time ago, in the course of some experiments dealing with the afterglow in mixtures of nitrogen and oxygen.

The electrodeless discharge was used with a spark gap, and the limits of pressure were about 1·8 to 0·01 mm. In a given mixture, for example, air, there is a sharp minimum in the duration and intensity of the afterglow at about 0·53 mm. pressure, which separates the yellowish-green oxygen afterglow (at higher pressures) from the orange-yellow nitrogen afterglow (at lower pressures). See also a note to NATURE (**121**, 938; 1928). In a certain pressure region in the neighbourhood of this minimum, a long discharge ($\frac{1}{2}$ second or longer) gives rise to a blue afterglow. At a suitable pressure the nitrogen-bands also appear faintly along with the blue glow and can be observed with a spectroscope. However, with a very short discharge (not measurable) only the yellowish-green afterglow is visible (continuous spectrum). Thus, different types of afterglows may be excited in the same gas mixture at the same pressure merely by altering the period of discharging. The same phenomenon can be observed in mixtures containing other proportions of nitrogen and oxygen but at different total pressures.

At a pressure where the transition from the yellowish-green to the blue afterglow commences (using $\frac{1}{2}$ second discharge), the former glow is displaced as a wave along the tubing leading from the discharge vessel while the latter glow occupies the vessel. The blue glow falls off in intensity, but is soon brightened up again by the return of the yellowish-green wave. (Compare Majewska and Bernhardt, *Zeit. für Physik*., **48**, 137; 1928, for observations on the progression of afterglow waves in air.)

BERNARD LEWIS
(National Research Fellow).
University of Minnesota,
Minneapolis, U.S.A.

Analysis of the First Spark Spectrum of Sulphur (S^+).

A VERY thorough study of the spark spectrum of sulphur was made by Eder and Valenta in 1904 in the region λ3301 to λ5819. In 1907, Sir Norman Lockyer showed that some of the stronger lines of S^+ occur in the spectrum of Rigel (class B8), but not in the spectrum of α-Cygni (Giant Ao), or Sirius (Dwarf Ao).

The clue to the analysis was obtained in the following way. Taking the structure diagram of S^+ the possible transitions are:

$$3M_2 \begin{matrix} \nearrow 2M_2M_3 \\ \searrow 2M_2N_1 \end{matrix} \qquad 2M_2N_2 \begin{matrix} \nearrow 2M_2N_3 \\ \searrow 2M_2O_1. \end{matrix}$$

The fundamental lines $3M_2 \longleftarrow \begin{matrix} 2M_2M_3 \\ 2M_2N_1 \end{matrix}$ lie in the ultra Schumann region, and Millikan and Bowen's data in this region are rather incomplete. The next groups, $\begin{matrix} 2M_2M_3 \\ 2M_2N_1 \end{matrix} \longleftarrow 2M_2N_2$, lie in the visible region.

The group $2M_2(N_1 \longleftarrow N_2)$ was located at $\nu = 18000$, by following the extension of the irregular doublet law given by Saha and Kichlu, and by treating the spectrum as the mean between those of P^+ and Cl^+ both recently analysed by Bowen. An examination of the tables of Eder and Valenta revealed a group of strong lines in this region.

A further clue was obtained from the fact that of these groups of lines only λ5454 and λ5033 were traced by Lockyer in the spectrum of Rigel. Hence these two lines were regarded as the strongest lines of the group $2M_2N_1 \longleftarrow 2M_2N_2$, namely, as ${}^4P_3 - {}^4D_4$ and ${}^4P_3 - {}^4P_3$. Both of these multiplets have been discovered. Δp_{12} and Δp_{23} of $2M_2N_1$ being respectively 270 and 437. The $4D$ differences are 151, 257, and 366.

With these multiplets as clues, the other strong groups identified by Lockyer at λ4142 - λ4174 with some lines in the spectrum of Rigel could be assigned to the ${}^4D - {}^4D$, ${}^4P - {}^4P$ groups of the transition $2M_2M_3 \longleftarrow 2M_2N_2$. They are not reproduced here.

D. K. BHATTACHARYYA.

Patna and Allahabad,
May 8.

Fluorescence of Mercury Vapour under Low Excitation.

IT has, I believe, been generally supposed that the green band fluorescence of mercury vapour cannot be excited by optical frequencies much less than that of the mercury resonance line. Houtermans, working in Franck's laboratory, has put forward the view that this green fluorescence results from the excitation of the molecule to the 2^3P_1 state, differing but little in energy from the corresponding state of the atom.

I have recently found, however, that this high frequency is not necessary to stimulate the green fluorescence. The most effective arrangement tried so far is to focus an iron or copper arc, or an 'atmospheric' mercury lamp, on a bulb containing mercury at atmospheric pressure. A filter consisting of a bromine cell and a sheet of blue uviol glass is interposed to cut off visual light. Under these conditions a bright green track is seen marking out the path of the rays in the vapour.

The shortest mercury wave-length that can get freely through the blue uviol glass is λ3125, and experiments with a monochromator have shown that this line excites the fluorescence. The strong line at λ3650 is unable to do so.

These experiments are being developed in various directions, and will be published more fully in due course.

RAYLEIGH.

Terling Place,
Chelmsford, Essex,
Aug. 4.

Radium in Cancer.

IN NATURE of Aug. 4, the writer of the article on Cancer Problems, after stating that substantial practical advance has been made in treatment by radium, concludes by saying, "At the same time there is no justification for any talk about surgery being eliminated."

At the International Conference in question there were discussions upon the relative value of surgery and radiology in the treatment of cancer in four sites of the body. At these discussions four British surgeons spoke in the following terms: one advocated the use of radium in operable breast cancer; one stated that he had given up the Wertheim operation for cancer of the cervix uteri in favour of radium; one described a series of cases of cancer of the tongue where the primary growths were treated by radium in order to avoid excision; and one detailed a method of radium treatment of cancer of the rectum, in operable and inoperable cases during the last two years.

When statements like these are made by surgeons themselves, would it not be more correct to say that owing to the advances in radium-therapy there is some justification for believing that in certain sites of cancer, radium may with advantage replace surgery?

SIDNEY RUSS.

The Middlesex Hospital, W.1,
Aug. 6.

PROF. RUSS gives the more correct description of the proceedings of the Congress: the lay press translated them with inaccurate exaggeration.

THE WRITER OF THE ARTICLE.

The Spectrum of Tribly Ionised Antimony, Sb IV

IN the case of the isoelectronic system Cd I, In II, Sn III, Sb IV, the X-ray doublet laws have been found to apply even though these spectra consist of singlets and triplets. Continuing our previous work on In II and Sn III, we have been able to identify several groups in the spectrum of Sb IV. These are a ${}^3P{}^3S$ multiplet, lying between 805 A. and 861 A., a very strong ${}^3P{}^3D$ multiplet, lying between 873 A. and 940 A., a ${}^3D{}^3F$ multiplet, lying between 2077 A. and 2113 A., and a possible ${}^3P{}^3P$ group between 1051 A. and 1193 A. The first ${}^3P$ separations are 5854 and 2261 cm.$^{-1}$. In addition to these, a ${}^1S{}^3P$ line and ${}^1S{}^1P$ line give an estimate of 340000 cm.$^{-1}$ for the lowest, ${}^1S$, level corresponding to an ionisation potential of about 42 volts.

In addition, second members of series have been identified in In II, and we are now looking for additional combinations in Sn III and Sb IV. A complete report will be published elsewhere.

J. B. GREEN.

Columbus, Ohio.

R. J. LANG.

Edmonton, Alberta.

The Corpus Luteum and the Cause of Birth.

As I pointed out in the article referred to by Prof. Thomson Flynn in NATURE of June 30, p. 1020 (*Biol. Rev.*, 2, 129; 1927), parturition is certainly due to several factors, of which the decline of the corpus luteum is probably one. Moreover, the enlargement of the pregnant uterus is also due to several factors. In the case of the sterile uterine horn in *Bettongia*, the partial regression of the corpus luteum in the absence of the fœtus may have been the main factor in the uterine involution. In the case of the other horn the enlarged condition of the uterine wall and the contained fœtus involve further factors in the continuation of pregnancy, and it may be that in their presence the regression of the corpus luteum was not sufficiently advanced to admit of the occurrence of birth at the time of the commencement of involution in the non-pregnant horn; that is to say, in order that parturition may occur, it may be necessary not only for the corpus luteum to be in a state of marked regression, but also for the uterine horn and contained fœtuses to be in a certain condition of development.

F. H. A. MARSHALL.

July 15.

Evidence of Survival of a Human Personality.

By Dr. R. J. TILLYARD, F.R.S.

"We are sitting in front of one of Nature's shows as a respectful audience. We are not to blame for the phenomena. We don't manufacture them. We don't have to defend them or explain them. Here they are for any honest man to behold."

Dr. L. R. G. CRANDON, *in litt.*

THE supernormal phenomena studied in the nascent science called psychical research are essentially phenomena associated with living organisms, and fall, therefore, within the limits of the wider science of biology. It has long been a reproach that biologists in general have refused to study them. For myself, I have been endeavouring, during the past five or six years to remove that reproach by studying them whenever opportunity presented itself. Two years ago, in the columns of NATURE, I pleaded for a recognition of the reality of the phenomena and asked that science should keep an open mind about them. At that time I was not convinced that the survival of a human personality, after the change which we call death, had ever been demonstrated, although I had to admit that there was much that was puzzling in the phenomena and much that could be most simply explained by accepting survival. As the result of further experiments with the remarkable Boston medium, Mrs. L. R. G. Crandon, I feel that a *scientific proof* of survival has at last been obtained, and it is the purpose of this article to set it before the reader of NATURE, who, one might venture to believe, would be interested in what appears to me to be, in Dr. Crandon's own words, "one of Nature's shows."

In submitting this proof, I desire to emphasise three things about it:

(1) The possibilities of fraud have been eliminated in two ways:

(*a*) By using such controls as the nature of each experiment clearly calls for if a charge of possible straight-out fraud is to be avoided.

(*b*) By devising experiments which, in their very nature, are either manifestly impossible to human beings in the flesh, or at any rate admittedly impossible under the conditions of actual performance.

(2) The experiments can be repeated time after time, and the same results obtained. In future, no scientist can level the charge of non-repetition against the experimenters of this particular group.

(3) The main proofs of survival obtained lie in phenomena which, whether of the so-called mental or physical type, are normally *impossible* of performance by human beings.

Before giving a condensed account of these phenomena it will be necessary for me to outline briefly the history of the mediumship which is now known widely in psychic circles as the 'Margery' mediumship. Margery's maiden name was Mina Stinson. She is now the wife of Dr. G. Crandon, a well-known Boston surgeon. She was born in Canada, and had a brother named Walter Stewart Stinson who was killed on Aug. 8, 1912, in a railway accident. There was a great affection between the brother and sister. The mediumship began in May 1923, with table-rapping and such-like familiar phenomena, but developed later into trance form, with a very striking characteristic, namely, the formation of an independent voice, not proceeding from the lips or throat of the medium, and claiming to be the voice of her dead brother Walter. This voice was quite strongly developed two years ago, and was tested very fully by me in two séances at the end of April 1926. The voice does not utter inanities or banalities, but shows a fully developed human personality, very masculine, forceful, and humorous, so that it tends to dominate the whole proceedings and clearly exercises an independent will of its own in relation to the other sitters. Many remarkable experiments have been performed through the agency of this control, which anyone may call 'Walter' without thereby committing himself to the belief that it is truly the surviving voice of Margery's dead brother.

Coming to Boston after an absence of more than two years, I had the privilege of attending and controlling four remarkable séances. The first two of these contain all that is requisite for a strict proof of the survival of the human personality of Walter Stinson. Even more remarkable were the results obtained in the third and fourth séances: but these logically form a portion of a series of experiments not yet completed, and therefore the account will be both simpler and clearer if I keep mainly to the first two.

The proof of survival lies along two well-marked lines, one of the mental type, namely, *supernormal cognition of unknown objects*, and one of the physical type, namely, *production of supernormal thumbprints*. The former type clearly belongs to the category of normal impossibilities, while the latter is probably of the same type, and should appeal more especially to biologists.

SUPERNORMAL COGNITION OF UNKNOWN OBJECTS.

Séance held at Dr. Crandon's house, 10 Lime Street, Boston, Mass., 9 to 10 P.M., May 31, 1928.

PREPARATION.—Accompanied by Mr. J. W. Evans, B.A. (Cantab.), a young entomologist who had never before been to a séance and had no interest or belief in psychic phenomena, I arrived at Dr. Crandon's house and proceeded to make the following preparations for supernormal tests:

(1) *Calendar Tests.*—Mr. Evans and I each obtained a calendar with separate sheets for each day of the month, slung together, by two punched holes, on a pair of metal rings. Going alone into another room, I took all the slips for the month of May off the rings, turned them over and signed each separately on the back. I then shuffled

them face downwards, like a pack of cards, replaced them on their rings, and put them into my pocket.

Mr. Evans dealt similarly with his calendar, selecting the month of September 1927.

Neither Mr. Evans nor myself, nor any living person, knew the order of the arrangement of the dates on these two calendars when we took them into the séance room.

The object of the test was to see whether 'Walter' could select numbers from the calendars in the dark, impress his results on Margery's mind by telepathic hypnosis, and cause her to write them down accurately in bright light after the séance was over. In addition, we had arranged to test 'Walter' for supernormal results at a distance, by asking another medium, Mrs. Sary Litzelmann, to sit at the same time at a tiny village called Ogunquit in Maine, about eighty miles north of Boston, and to report her results to us later in the evening by trunk telephone.

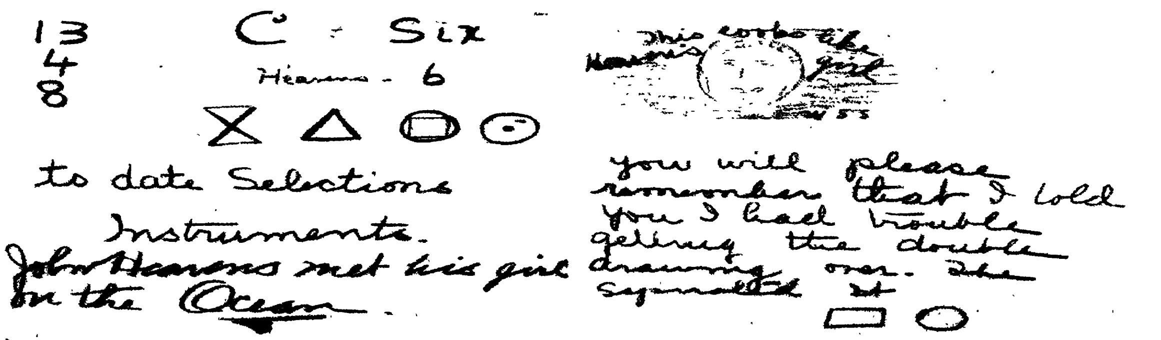

FIG. 1.—The two pages of script written by Margery in bright light in the drawing-room after the first séance. (Reduced to one-fourth natural size.)

(2) *Drawing Tests.*—In order to rule out the charge that I myself might be an accomplice of the Crandons, I entrusted this test entirely to Mr. Evans. He took some slips of paper and made a number of diagrammatic drawings on them, ten in all, which he then shuffled face downwards and tied together by string. These were taken into the séance room in his pocket.

Mr. Evans knew the diagrams, but not their order; nobody else knew what they were at all.

(3) *Magazine Tests.*—Mr. Evans went into Boston a few minutes before the séance began, having previously listed all the magazines which he could find in the Crandons' home, and bought one which had only just been issued and was not taken by the Crandons, viz. the "Radio Listeners' Guide and Call Book" for June 3, 1928. He slipped this under his coat and brought it secretly into the séance room.

Nobody but Mr. Evans knew the name of the selected magazine, and nobody in the séance room knew any of its contents.

As a full report of this and the succeeding séances would be out of place here, and will be published elsewhere later,[1] I will confine myself to a general statement of what actually happened at the first two séances.

The medium having been searched by one of the women sitters, the circle was formed, with the medium controlled by myself on her left side and by Dr. Crandon on her right side; lights were turned out, the door having been previously locked by myself and the windows barred and shuttered. The darkness was so intense that I could see no more at the end of an hour than at the beginning.

Under these conditions, the first phenomenon which occurs is always the production of 'Walter's' psychic voice. This voice is objective, as it has been recorded on the dictaphone; it does not proceed from the medium, but from a point in the air outside her, sometimes near, sometimes quite a considerable distance away. By means of the Richardson Voice Cut-off Machine, now almost too well known to need description, it is possible to wake the medium up and block her mouth completely, also those of all the other sitters at the same time, yet 'Walter's' voice is still produced as loudly as ever under these conditions, and has been tested by me a number of times, and by many other investigators. I have also heard it speak in bright red light, while watching the lips and larynx of the medium carefully, and I have noted that the normal position from which the sound issues is a point about eight to ten inches in front of the medium's upper abdomen. The voice is masculine, fairly loud, slightly hoarse, and its possessor has a really remarkable power of whistling.

With running humorous comments by this voice, the next phenomena noticeable are movements and the handling of objects placed on the table within the circle. On presenting my calendar by laying it on the table just in front of my face, 'Walter' at once handled it and tore a number out; soon afterwards he returned it to me by neatly placing it between my thumb and the medium's left hand which I was holding. Three numbers were similarly torn from Mr. Evans's calendar, one of these being stated by 'Walter' to be 'Heaven's special number.' Four drawings were also torn from Mr. Evans's set and given to me, and finally six pieces were torn from the pages of the magazine which had been presented to 'Walter.' All these, returned by him to me in the same way, were carefully put aside, some in my own pocket, some by Mr. Evans, and one or two passed to other sitters.

During the séance, 'Walter' several times asked for quiet and said he was off to Ogunquit. On the

[1] *Proc. Nat. Lab. Psychical Research*, vol. 1, part 2, to be issued about September 1928.—R. J. T.

third occasion, after announcing his return, he appeared worried, and said that he had not been able to get 'Sary' to reproduce a drawing properly; it was a double drawing, and "she had separated it."

The dark séance ended at 10 P.M., the medium woke up and we all adjourned downstairs to the drawing-room. I went down with Margery; Mr. Evans brought up the rear, seeing that all the other sitters came into the room within a very short time. Nobody spoke to the medium. I sat down beside her on a sofa, with the telephone close by on the mantel-piece, and pencil and paper handy, in bright white light. Soon Margery said she wished to write, and I handed her the paper and pencil. She wrote the two sheets reproduced in Fig. 1. We then produced all the numbers, drawings, and magazine pieces which Walter had handed to me during the séance, and found that they corresponded exactly with what Margery had written. The '8' was my number: 'Heaven's special number' was the '6'; and the other two from Evans's calendar were '13' and '4.'

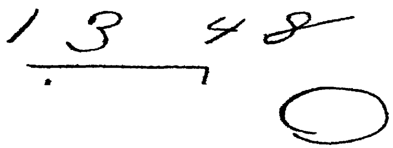

FIG. 2.—Portion of the script written by Mrs. 'Sary' Litzelmann at Ogunquit, Maine, 80 miles away from Boston, during the time of the first séance. (Reduced to one-fourth natural size.)

We did not fully understand the allusion in Margery's writing about the double drawing until about ten minutes later, when I took a trunk call on the telephone and found it was from Mrs. Litzelmann at Ogunquit. She dictated her results

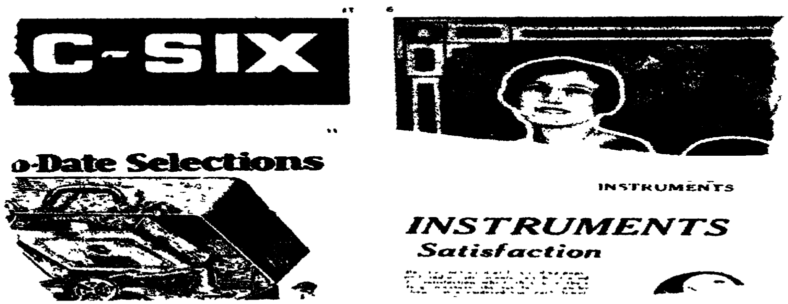

FIG. 3.—Four of the magazine pieces torn out by 'Walter' during the first séance.

through the telephone to Mr. Evans, and also posted them, signed by all her circle of sitters, the following day. Though not so fully accurate as Margery's, it will be seen from Fig. 2 that she had some remarkable successes, getting three out of the four numbers, and also reproducing the very drawing, which 'Walter' and Margery both commented on, as a square alongside a circle instead of a circle inside a square.

It does not seem necessary here to reproduce the calendar numbers or Mr. Evans's drawings, but Fig. 3 shows the four most striking of the magazine selections, which should be carefully compared with Margery's writings.

The remark, written by Margery, that "John Evans met his girl on the Ocean," refers to the fact that he had become engaged on the voyage across the Pacific the previous month. This fact was not known to anybody in Boston.

In case anybody should direct attention to the fact that Dr. Crandon had control of his wife's right hand and leg during this séance, I must mention that, two evenings later, I replaced Dr. Crandon by a stranger, Capt. Fife. Under these conditions, equally good results were obtained.

This article cannot be extended to discuss the results. It seems to me that they speak for themselves.

SUPERNORMAL PRODUCTION OF THUMB-PRINTS.

Séance held at Dr. Mark Richardson's house, 117 Lake Avenue, Newton Centre, Boston, Mass., eight miles from Dr. Crandon's house, 9.30 to 10.15 P.M., June 1, 1928.

PREPARATION.—The venue was changed in order to eliminate possible charges of fraud connected with apparatus or fittings in the Crandon's séance room. Dr. Crandon also agreed to my desire for a séance at which he and all the usual members of his circle should be absent. The only other sitter besides myself was Capt. Fife, the finger-print expert of the U.S. Navy Yard.

I took an unopened box of the dark-red dental wax called 'Kerr,' opened it myself, counted eight pieces inside, took out three and gave them to Mr. Evans, and kept five myself. Each piece was then marked secretly on the back by us, a number given to it, and a piece broken off from the side. The eight smaller pieces were placed in a box, for purposes of verifying the counterparts later. The eight larger portions were placed in the original box and carried out to Dr. Richardson's house in my pocket.

The room selected for the séance was a small annex of a larger room, only opening from the latter by a door, and with a high barred window. In this room we arranged a small table, three chairs, and a red shade over the electric light. No cabinet or gramophone. For the purpose of making thumb-prints, a kettle of hot water had to be provided, also a jug of cold water, a folded cloth, and two dishes. The procedure is to pour hot water into one dish until the temperature is about 140° F., the cloth being placed in the dish of water. The plate of 'Kerr' is then placed on the cloth under the hot water until it is sufficiently soft, when the cloth is drawn out on to the table. One can then press one's thumbs into the wax, which sticks tightly to them until it is quite cooled down.

With only the medium, Capt. Fife, and myself present, Mr. Evans guarding the door outside, and with red light frequently turned on to verify the position of the pieces of 'Kerr,' to remove each one from the cold water when Walter reported it done, or to put in a new piece into the hot water when he asked for it, we had a most extraordinarily quick and accurate performance by 'Walter' of the technique of making thumb-prints. In taking

Margery's, Capt. Fife's, and my own thumb-prints, which I did in bright light within a few minutes of the end of the séance, considerable difficulties were met with, especially owing to the wax melting too much if the water were too hot, and sticking closely to the thumb until the water was quite cool. I timed Capt. Fife, a finger-print expert, taking one of his own thumb-prints, and it took him ten minutes. 'Walter' did seven good prints in the dark in about half-an-hour, remarking, *en passant*, that it was easy for him, as he "carried his cold about with him."

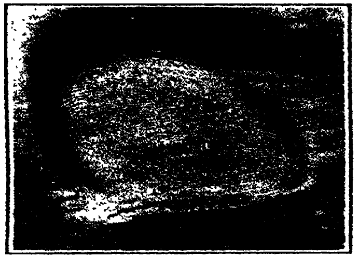

FIG. 4.—Margery's (Mrs. Crandon's) right thumb-print.

The procedure for each thumb-print was as follows: When the hot water had been poured into the dish by Capt. Fife, and the cloth suitably arranged in it (the medium being asleep and with her two hands and legs fully controlled by us), the red light was turned out by myself. 'Walter' would wait until the water had cooled to the requisite temperature, and would then ask me to put a cake of 'Kerr' into the dish. When I had done this, we could hear movements in the water, and soon the cloth would be dragged out of the dish and the 'Kerr' removed to the cold water. 'Walter' would then tell me to put the light up, and I would take the 'Kerr' out of the dish, examine it, note the presence of a thumb-print, put it aside into my box, and get ready for another.

By inadvertently failing to follow Walter's directions, I twice caused him to talk in bright red light. On one occasion he said "No," in a loud voice, as I was about to put some 'Kerr' into the dish. On the second occasion, while I was looking straight at the medium, he said, "Go ahead, put it in." I noted that neither the medium's lips nor her larynx moved at all.

FIG. 5.—Captain Fife's right thumb-print.

When doing the fourth print, 'Walter' said that it would prove to be a mirror-image of his ordinary thumb-print. This we verified as correct later.

During the séance I was frequently touched and stroked by 'Walter's' teleplastic terminal, and water was several times sprinkled over me.

An examination of the prints showed that there were seven clear right thumb-prints in all, two of them being on No. 6. No. 4 differed from the rest, and a later examination showed that it was a positive mirror-image.[2] All the rest were negative. All seven belonged to the same thumb and were markedly different from the thumb-prints of Margery, Fife, and myself. The next evening I took the thumb-prints of all the usual circle of sitters, including Dr. Crandon, and these also were found to differ from 'Walter's.' A comparison of the 'Walter' thumb-print with a portion of the ulnar area of his actual thumb-print made during life, and found on his razor (used on the morning of the fatal accident in 1912), has been made possible through the fact that his old mother, who is still alive but very infirm, had preserved this and other treasures untouched since the day of the tragedy. The ulnar area of the prints obtained supernormally agrees exactly with that on the handle of the razor.

The eight smaller pieces of 'Kerr' were then produced by me, and six of them were easily fitted to the six retrieved from the cold water in the séance. The secret marks, numbers, etc., were also verified, though some of them were more or less obliterated through flowing of the wax in the hot water.

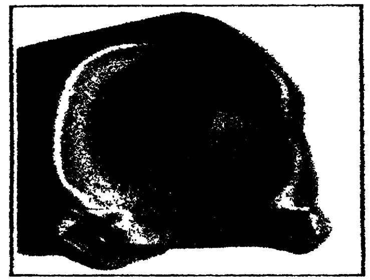

FIG. 6.—'Walter's' right thumb-print Normal negative.

I should like to summarise the results of the above two séances as follows:

The *personality* of 'Walter' is shown to be independent of that of the medium by the possession of a distinct, masculine voice and strong whistling powers, these never proceeding from the mouth or larynx of the medium; by his alert mental powers, tendency to impatience and the use of swear words, by a marked sense of humour, a Canadian accent, and many other qualities which cannot fail to produce in a sitter the definite feeling that he is dealing with an independent personality. Besides this, 'Walter' shows that he has the power of smell, can see in the dark, can handle delicate objects and place them accurately in the dark without doing any damage. He can select and cognise objects not known to any living person in the world, thus proving that he does not depend on telepathy or knowledge stored up in any person's subconscious mind. He can hypnotically influence the medium to write down his selected results, and can also influence mediums sitting at a great distance to do the same. Finally, he can produce his thumb-prints in dental wax in the dark more quickly than an ordinary man can do them in the light.

Experiments closely similar to the above are now being done twice a week regularly by 'Walter,' and it is therefore within the power of any man who wishes to do so to verify the phenomena stated in this article. My own conclusion is that Walter Stinson, who died in 1912, has fully proved *in a scientific manner* his claim that his personality has survived physical death.

[2] A *negative* impression is the same as would be obtained by pressing a normal human thumb on wax. A *positive* is the same as the actual pattern on the thumb itself.—R. J. T.

The Glasgow Meeting of the British Association.

LOCAL ARRANGEMENTS.

THE preliminary organisation of the British Association's impending visit to Glasgow is being greatly facilitated by the very unusual circumstance that two out of the three local officials—Prof. Magnus McLean and Sir John S. Samuel—held office at the last meeting of the Association in Glasgow twenty-seven years ago: Sir John Samuel was indeed acting secretary then as he is now.

An outstanding feature of the last Glasgow meeting was the excellent and comprehensive handbook in three volumes prepared in connexion with it, and still in use, so far at least as its biological sections are concerned, as a standard work of reference. The possibility of anything on a similar scale for this year was unfortunately ruled out by the greatly increased cost of book production, but a handbook on a small scale, composed of lightly written articles on local topics likely to be of interest to scientific visitors, has been prepared under the editorship of Prof. Graham Kerr, and will be distributed to members at the commencement of the meeting along with topographical and geological maps of the district.

In one respect, namely, as a centre for excursions, Glasgow is probably without a serious rival amongst all the cities in which the British Association holds its meetings, and the visitor who has only the Saturday available may find himself seriously embarrassed by the richness of choice before him. A detailed programme of excursions has been prepared, and prospective attenders at the Glasgow meeting will do well to peruse this as soon as it is received and to take the precaution of indicating at once to the local secretaries their order of preference as between the various excursions. This will facilitate the organisation of the various parties, which are for the most part limited to a certain number.

Another outstanding attraction of the Glasgow meeting will be the opportunity it affords of paying visits of inspection to industrial concerns on a large scale, such as shipyards, engineering works, iron and steel works, printing works, biscuit factories, etc., the owners of many of which have kindly offered facilities for viewing their works. To the scientific visitor it is of remarkable interest to witness the workings of, say, a modern biscuit factory: in the multiplicity and specialisation of its parts, all functioning in smooth co-operation with one another, it irresistibly recalls to his mind the impression of a highly evolved living organism.

Glasgow is a city of wide distances, and although the official business of the Association will be concentrated in an unusually small area, visits to works and other sights will involve a considerable amount of travelling. The free transport granted by the Corporation upon their trams, buses, and subway will consequently be much appreciated; for river transport—to make it possible to view the harbour of Glasgow with its fringe of shipyards—the Clyde Trustees have arranged that one or other of their vessels *Comet* and *Clyde* shall leave the Broomielaw at 2.30 on most days during the meeting, for a two-hour voyage of inspection.

In the Queen's Dock on Sunday, Monday, and Tuesday, Sept. 9, 10, and 11, the Scottish Fishery Board's research vessel *Explorer* will be open for inspection by members of the Association interested in oceanography or marine biology.

As befits the city the ancient motto of which reads, "Let Glasgow flourish by the Preaching of the Word," there will be ample opportunities open to the churchgoer on Sunday, Sept. 9. The official sermon will be preached by Dr. MacLean Watt, minister of Glasgow, in the ancient Cathedral Church of St. Mungo. At St. Mary's Cathedral a large congregation will doubtless be attracted by Father Waggett, while in numerous other churches belonging to different denominations the sermon will relate more or less directly to the British Association and its work.

The daily interval between the afternoon session of the various sections and the evening functions is being taken advantage of by various public bodies for providing hospitality in the form of 'At Homes.' Amongst these are the Royal Technical College, where visitors will have the opportunity of inspecting one of the most important establishments in Britain devoted to technical education; the great Training College at Jordanhill with its magnificent buildings and grounds: the Roman Catholic Training College, Dowanhill, conducted by the Sisters of Notre Dame, and of high repute alike for its efficiency and for the quality of its research output; the College of Domestic Science; the Royal Faculty of Physicians and Surgeons; the Institution of Engineers and Shipbuilders; and the Trades House—an ancient incorporation which does noble work behind the scenes in secretly extending help to the less fortunate.

A large proportion of the well-to-do citizens of Glasgow are away from home during early September, and this is likely to be a limiting factor as regards private hospitality, but of more public hospitality there will be much. Glasgow has a number of admirable clubs, and the majority of these are generously admitting non-resident members of the British Association as honorary members for the period of the meeting, and the same applies to numerous golf clubs in the neighbourhood.

The importance should again be emphasised of members who propose to attend the Glasgow meeting sending in their names at once if they have not already done so, alike as a help to those who are organising the meeting and as a precautionary measure against finding themselves crowded out from excursions or other functions which they may desire to attend.

Obituary.

Dr. Finn Malmgren.

DR. FINN MALMGREN, who, after the wreck of the airship *Italia* in the Polar regions in May, lost his life in a brave effort to cross the ice on foot with two companions to North-East Land, Spitsbergen, was a Swedish meteorologist of considerable achievement and great promise. Educated at Upsala University, he became assistant to Prof. Hamberg at the high altitude observatory at Portetjäkko, whence he returned to Upsala to work at the meteorological observatory. Later he served at Pettersson's Hydrographic Institute at Bornö.

Dr. Malmgren's first polar experience commenced in 1922, when he became assistant scientist under Dr. Sverdrup in Amundsen's expedition in the *Maud* during the two years' drift in the polar ice. Returning to civilisation in 1925, Dr. Malmgren was soon engaged again in polar work, for he was one of the small body of men which crossed the north pole in the airship *Norge* during the Amundsen-Ellsworth expedition from Rome to Alaska in 1926. This year he responded yet again to the call of the polar regions, when, on the invitation of General Nobile, he became meteorologist on board the airship *Italia*, in which Nobile intended to carry out flights over the polar basin for scientific purposes from a base at King's Bay, Spitsbergen. After flying from Milan to Spitsbergen, two flights were carried out in the direction of Nicholas II. Land, and it was during the return from the north pole on the third flight that the accident happened to the airship which led to Dr. Malmgren's tragic end, at the early age of 32 years. The airship had, however, reached the pole, and Dr. Malmgren was therefore one of the few men who have been there twice.

Of Dr. Malmgren's contributions to scientific literature, perhaps that best known is the work summarising his observations of humidity and hoar frost in the *Maud*, for which special instruments were devised in view of the small water content of the air at the low temperatures experienced.

Dr. Malmgren was not unknown personally in England, for during the call of the *Norge* at Pulham on her way to the north pole an opportunity was afforded of appreciating his vivid personality. In the meteorolo[illegible] ...ting his extensive scientific experience of the polar regions must now go unrecorded.

M. A. G.

Mr. Frank Castle.

THE death of Mr. Frank Castle on Aug. 4, at seventy-one years of age, will be regretted by a wide circle of friends and by thousands of artisan students who have profited by the courses of instruction in his text-books of practical mathematics and related subjects. Mr. Castle was born at Dewsbury, Yorkshire, and served his apprenticeship with a firm of engineers and tool-makers there. After working at his trade and introducing several improvements in grinding machinery, he became in 1883 an assistant in the mechanics and mathematics division of what is now the Royal College of Science, South Kensington, and he occupied that position for twenty-six years. Hundreds of students who passed through the College during that period will remember his retiring nature and are grateful for the assistance he was ever ready to afford them on either the mechanical or the mathematical side of their work. When Prof. John Perry, who was appointed professor of mathematics and mechanics at the College in 1896, was carrying on there his campaign for the teaching of everyday or practical mathematics, Mr. Castle became an enthusiastic exponent of the reform, and in quick succession produced his "Practical Mathematics for Technical Students" (1899), "Practical Mathematics for Beginners" (1901), and "A Manual of Practical Mathematics" (1903), all of which became standard text-books and remain so even now. He was the author also of "Machine Construction and Drawing," "A Manual of Machine Design," and several useful books of mathematical tables. His success as an author and a teacher was due to his early workshop training and an instinctive appreciation of the difficulties of elementary students. He was for many years lecturer in mathematics at the Morley College, London, and at the time of his death was lecturer in practical mathematics, machine construction and drawing, building construction and applied mechanics at the Municipal Technical Institute, Eastbourne.

News and Views.

THE bicentenary of the birth of the great navigator Captain James Cook is to be celebrated in the Cleveland district of Yorkshire on Sept. 8 and 9. Cook was born in the village of Marton, Yorkshire, on Oct. 27, 1728, and though as a boy he was apprenticed to a haberdasher near Whitby, he gained his first experience at sea in a Whitby collier. At the age of 27 he joined the Navy as a volunteer, and as such soon attracted attention. He was present at the capture of Quebec, surveyed the St. Lawrence from Quebec to the sea, and was made marine surveyor of Newfoundland and Labrador. His three great voyages of exploration occupied the years 1768–1771, 1772–75, and 1776–79. The primary object

of the first was to observe the transit of Venus of 1769 at Tahiti; that of the second to discover the boundaries of the lands of the Antarctic; that of the third to discover a passage from the North Pacific to the North Atlantic. His work not only added immensely to geographical knowledge, but it whetted the public appetite for further discoveries. He did more than any other explorer to extend our knowledge of the Pacific and the Southern Ocean, and an interesting feature of the forthcoming celebrations will be the presence of the High Commissioners of New Zealand and Australia.

ON July 29, M. Herriot, Minister of Education, unveiled at Lyons a monument to Chardonnet, the inventor of artificial silk, who, he said, was worthy to rank between Pasteur and Berthelot, and had deserved well as a savant and a philanthropist. Chardonnet's invention was the result of a long and laborious research carried out at his laboratory at Besançon. Born on May 1, 1839, Comte Hilaire de Chardonnet received his scientific training in the École Polytechnique. He then travelled abroad, and after settling down strove for many years to realise Réaumur's suggestion that silk might be made artificially. It was on May 12, 1884, he took out his first patent "Sur une matière textile artificielle ressemblant à la soie," and by so doing took the decisive step towards the creation of an entirely new textile industry. The result of his work was made known in 1889; in the Paris Exhibition of that year he exhibited specimens of his material, with the result that money was found for erecting a 'Chardonnet Silk' factory at Besançon. Chardonnet died at Rome in 1924.

VARIOUS references have been made in the technical press to the fact that it is just fifty years since Sidney Gilchrist Thomas and his cousin Percy Gilchrist brought to a successful issue their experiments on the elimination of phosphorus from mild steel, and thus laid the foundation of the basic steel industry. In 1878 all steel, whether produced in the Bessemer converter or the open hearth furnace, was acid steel, the world's output being about $2\frac{3}{4}$ million tons. During 1927 the world's production of steel ingots and castings was about 99 million tons, and this enormous increase is largely due to the basic steel manufacture, more than 84 per cent of the total being basic steel. Thomas was led to his researches by a remark of a lecturer at Birkbeck College, and his experiments were made while he was still a clerk in a Stepney Police Court. He began studying the problem of the dephosphorisation of pig-iron in 1870 at the age of 20. Eight years later he announced his success at the Iron and Steel Institute. Seven years afterwards, while still under 35 years of age, but regarded as "the most promising light of the steel world," he died in Paris and was buried in Passy Cemetery.

IN recent years all the world has become interested in tales which illustrate certain mental traits of the Aberdonian; many of these stories, it is alleged, emanate from the city of Aberdeen itself. However this may be, it is quite clear from a paper which Dr. James Ritchie, of the Royal Scottish Museum, himself a distinguished native of Aberdeenshire, contributes to the *Aberdeen University Review* of July, on "The Genius of the Aberdonian," that the native of the North-East of Scotland has other gifts than those of parsimony. Havelock Ellis, in his "Study of British Genius," found that Scotland produced an unfair share, and that among Scottish counties, Aberdeenshire came out almost at the top of his list. Dr. Ritchie cools this compliment by pointing out that if its former population is taken into account, Aberdeenshire sinks to the tenth position, but "still stands far above the average of Scotland's production of genius." What is the characteristic mentality associated with the genius of the North-East? Dr. Ritchie asks. His answer is: "It is a bent for minute, detailed work; for accuracy in small things. And having laid this sound foundation, it exhibits itself in the logical piling up of premises and the deduction of laboriously won conclusions. Lofty imagination is foreign to the nature of the North-East."

THERE are traits which have been traditionally ascribed to the German men of science. It is a remarkable fact that in the second millennium before Christ, a 'beaker' people, a peculiar breed of round-headed folk, of short stature, began to settle in the north-east corner of Scotland. All the evidence at present at our disposal leads us to trace these people to a home in a part of Europe which is now held by a German-speaking population. There is much to be said for the thesis maintained by Dr. Ritchie that the modern Aberdonian owes much of his mental outfit to these 'beaker' ancestors. Whether Dr. Ritchie owes his lucidity of statement and charm of style to his beaker ancestry or to his University, is a moot point; they are certainly not Germanic.

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Dr. Malmgren's death is to be deplored, not solely on account of his promise of brilliant scientific work in the future, but because much of his extensive scientific experience of the polar regions must now go unrecorded. M. A. G.

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WE much regret to announce the death on Aug. 12, at sixty-eight years of age, of Dr. Charles Chree, F.R.S., superintendent of the Kew Observatory from 1893 to 1925 and a leading authority upon terrestrial magnetism, atmospheric electricity, and related subjects.

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the staff investigated a serious mosquito annoyance in a North London suburb and found it to be due to *Ædes vexans*, a species which, though common in many parts of the world, is very rare in Britain, for only about a dozen specimens had previously been found. The council points out that the Institute is the only existing institution entirely devoted to mosquito control research and that it affords the only opportunity available in Great Britain for the practical study of a mosquito control scheme in actual and continuous operation. The council records its high appreciation of the devoted services rendered by the director and adds that he continues to bear the chief cost of the Institute. It is to be hoped that subscriptions from those interested, and grants from scientific or other public bodies, will be forthcoming so that the Institute may approach a more satisfactory, self-supporting position.

IT is announced that the exhibition of last season's finds at Ur at the British Museum is to remain open until a late date in the autumn. This is a welcome addition to the facilities which have been afforded the public to view one of the most remarkable collections of objects which have yet been brought from Mesopotamia or perhaps from any area of archæological exploration at one time. It places beyond question the artistic and technical pre-eminence of Mesopotamia at as early a date as 3000 B.C. In this connexion it may be noted that although Dr. Hall's lecture on Ur before the Royal Society of Arts, which is printed in the issue of the Society's *Journal* for July 27, was a survey of past work which did not attempt to throw fresh light on the results, one or two interesting points emerged both in the lecture itself and in the discussion which followed and is reported with the lecture. Mr. J. W. Wilson, formerly Director of Public Works and Antiquities in Iraq, pointed out the value of the explorations for the history of architecture: Babylonia shows evidence of early town planning; while the history of the brick can be followed from its earliest beginning as an unbaked lump of natural clay. He himself as officer in charge of public works had been responsible for the making of bricks, but for some reason he had not been able to ascertain, whether owing to some change in the nature of the soil, or the loss of some secret process which the ancient brickmakers possessed, he had been unable, even with the assistance of modern machinery, to manufacture a brick which equalled that of Hammurabi or Nebuchadnezzar.

DR. HALL gives some interesting figures relating to the cost of the work in Mesopotamia. His own work of excavation in 1919, which turned out to be more than a preliminary recognizance, cost £600. The expenses of a good season's work to-day are not less than £4000. The charges for the work being carried on at present are borne equally by the British Museum and the University Museum of Philadelphia. The British Museum, which has other calls upon it, is strictly limited in the amount which it can place at the disposal of the Ur expedition without assistance from the public. It will be remembered that last year Mr. Woolley had to close down for lack of funds when he had barely touched one of the most interesting and important finds of the whole of the work yet carried out. Material of priceless value, as was shown by the first turn of the spade in the next season, was exposed to the risk of plunder for months. This in itself should be enough to convince the public of the desirability of supplementing the Museum's funds in carrying on what Dr. Hall characterises as "the most important archæological investigation in the world at the moment."

AN exhibition case to illustrate the fluorescence of minerals (and some other substances) in ultra-violet rays has been fitted up near the entrance to the Mineral Gallery in the Natural History Museum at South Kensington. This is probably the first public exhibit of the kind, and during the August Bank Holiday week it attracted thousands of visitors. Marvellous changes in colour effects are produced by simply pressing a button outside the case. The specimens are first seen in ordinary light with inside electric lighting ('linolight'). When the button of the two-way switch is pressed, this changes over to ultra-violet rays, which are produced by a Hanovia 'artificial sunlight' mercury-vapour lamp fitted with a dark screen to cut out all the visible light rays, allowing only the dark ultra-violet to fall on the specimens. Large groups of fluorspar crystals shine up with a wonderful bluish-violet glow, willemite and autunite with a brilliant green, black zinc-blende with a golden yellow, and white calcite with a rose-red. When the spring-switch is released this fairyland of glowing colours suddenly vanishes. In the adjoining wall-cases a display has been made with a series of large specimens of well-crystallised spar, from the Snailbeach mine in Shropshire, recently bequeathed to the Museum by the late manager of the mine. The largest slab measures $5\frac{1}{2} \times 3\frac{1}{2}$ feet, and weighs over $8\frac{1}{2}$ cwt. With inside electric lighting ('linolight') and a dark grey background a striking effect has been obtained. A description of this new exhibit appears in the *Natural History Magazine* for July.

IN the *Times* of Aug. 7 is an account of the nomadic companies of market gardeners of Bulgaria which is of considerable interest to geographers and economists. These gardeners live in Tirnovo and the adjacent areas in the rolling country lying between the Balkan Hills and the Danube, where there is a long tradition of efficient practice in market gardening. As, however, the district is too thickly populated for the volume of local agriculture, it is the custom for small bands of twelve to fifteen to migrate for the season to less densely occupied land in Rumania, Russia, Turkey, Serbia, and elsewhere. Hiring land, they prepare the ground and raise a crop, of which they dispose in the market which they had in view in choosing their land, at a considerable profit to themselves. Even among the more primitive peoples, agriculture is normally a sedentary occupation, unless it is combined with the pastoral life and a seasonal migration as among some of the peoples of the mountainous areas of

Asia Minor. Something analogous to the Bulgarian practice occurs among peasant populations, for instance, Ireland and Brittany, who leave their own country to seek employment in the harvest elsewhere. This, however, is merely a special, if not too common, instance of the mobility of labour, whereas the extension of the principle of mobility in agriculture in search of suitable ground to such a degree as to justify the term 'migratory' in the Bulgarian instance is probably unique.

In an article entitled "Chaucer's Physician and his Forbears" in the current number of the *Nineteenth Century*, Dr. H. H. Bashford deals with the physician who figures in the prologue to the "Canterbury Tales" and his predecessors, particularly Gilbert the Englishman and John of Gaddesden. Chaucer's physician, though apparently of an avaricious disposition, is described as 'a verrey parfit practisour' and well versed in old medical lore. Although Bald's Anglo-Saxon "Leech Book," the earliest medical treatise composed in Great Britain, was written soon after the death of Alfred the Great, no great figure emerged from Anglo-Saxon medicine, and Gilbert, who was born about a hundred years after the battle of Hastings, was the first Englishman to acquire a European reputation as a physician. After study at Salerno, Montpellier, where he is said to have been chancellor, and Paris, he returned to England, where he acquired fame by his "Compendium" or "Laurea Medicinæ," which covered the whole field of medicine and contained a certain amount of original observation and research. He was the first, for example, to recognise the contagious nature of small-pox, and also emphasised the importance of surgical treatment for cancer and of a fruit diet for sea travellers. John of Gaddesden, who was born in 1280, fifty years after Gilbert's death, studied at Oxford, which since the time of Gilbert had possessed a medical school, and settled in London, where he composed his treatise entitled "Rosa Medicinæ," which rapidly obtained a great success. He became court physician, in which capacity he cured one of the royal family of small-pox by the first application of red light treatment, resuscitated centuries later. It is noteworthy that both these physicians had a belief in magic. Gilbert, for example, included in his treatise an impressive list of legendary antidotes, while John of Gaddesden, like his successors for many subsequent centuries, had a firm belief in the efficacy of the royal touch.

A beet-sugar factory has recently been found polluting the River Barrow at Carlow and fouling the machinery of a local miller, who is entitled under his lease to a supply of uncontaminated river water. The case is of interest to readers of Nature, as it is the first time, in Ireland at any rate, that a *biological*, as distinct from a chemical, analysis has been accepted in a court of law as evidence of pollution. Dr. T. Johnson, of Dublin, found the two *indicator* organisms—*Sphærotilus natans* and *Leptomitus lacteus* in the filter bed, the effluent, and the mill premises. They are microscopic fungi living on nitrogenous matter. 'Lambs' tails' may be used as a common name for them, as in mass they look alike.

Mr. H. Keijser, of the Koninklijk Nederlandsch Meteorologisch Instituut, has forwarded a barogram obtained on board the Dutch steamer *Sapæræa* when passing through a typhoon about 400 nautical miles east of Luzon. The barogram was of the extremely sharp 'V' type usually obtained on such occasions, and pressure fell so much that the pen quickly passed off the chart. Readings of a mercurial barometer were accordingly made, and the lowest pressure was observed to be 665·1 mm. (886·8 millibars) after correction for temperature, gravity, and height above sea-level. This reading was checked by several persons, and there seems to be no reason for not accepting it as correct, in which case the previous lowest reading of 918·9 m.b. obtained on Sept. 22, 1885, at False Point, Orissa, India (Nature, vol. 35, p. 344), no longer constitutes a 'record' for tropical cyclones. It should, however, be pointed out, that in tornadoes much lower pressures occur, but since a severe tornado usually destroys all buildings that lie directly in its path, we have no exact knowledge as to how low pressure may fall.

In a letter entitled "Pleochroic Haloes and the Age of the Earth." Dr. Franz Lotze (Göttingen) expresses the view that, even when we use the determinations of the range of the α-particles from uranium I and uranium II recently carried out by G. C. Laurence, there still exists a slight discrepancy between the theoretical and observed ranges in biotite. He interprets this as indicating a change in the medium produced by the radiation, rather than an alteration in the radioactivity of the contained uranium during geological time. The second possibility cannot be accepted in the absence of unequivocal evidence in its favour, and Dr. Lotze feels that his suggestion of an alteration in the cohesion properties of the mica (Nature, Jan. 21, 1928, p. 90) is ample to meet the case. He considers that Prof. Joly's criticism (Nature, Feb. 11, 1928, p. 207) of the letter cited is scarcely justifiable in view of the uncertainty of the relevant experimental evidence, and explains the fact that such anomalies are not observed with thorium and emanation haloes as being due to the smallness of the effects to be expected, as pointed out in his previous letter. Dr. Lotze sees confirmation of his own views in the recent work of Dr. J. H. J. Poole and of Dr. K. C. Bailey. Chemical and physical changes undoubtedly occur in the region of the inner haloes, and further work on this subject is much to be desired, so that quantitative effects can be predicted, and compared with observational data on the haloes. Such altered minerals may be attacked more readily by rock moisture and suffer a partial loss of their mineral constituents. Finally, Dr. Lotze advocates a thorough investigation of the medium in which thorium as well as uranium haloes occur, with the object of determining whether similar anomalies are to be found in minerals other than in biotite.

Dr. L. de Broglie has accepted the invitation of the British Association to attend the Glasgow meeting as a foreign guest and to take part in the discussion in Section A on the scattering of electrons from crystals.

THE Secretary of the Department of Scientific and Industrial Research informs us that he understands from the Spanish Ambassador in London, that the National Association of Olive Growers of Spain have extended until Oct. 31, 1928, the period for acceptance of entries for the international competition for oil analysis organised by that Association. Particulars of the competition will be found in NATURE of June 2, p. 880.

THE appointments to scientific and technical departments made by the Secretary of State for the Colonies during the month of July include two agricultural officers, Mr. A. H. Savile, and Mr. N. V. Rounce, to Tanganyika Territory; one government veterinary surgeon, Mr. J. F. Timoney, to the Straits Settlements, and one veterinary officer, Mr. H. A. Hay-Barclay, to the Agricultural Department of Kenya; an assistant cotton botanist, Mr. H. R. Hosking, to Uganda; a plant breeder, Mr. E. R. Guest, to Iraq; an entomologist, Mr. R. W. E. Tucker, to Barbados; and a produce inspector, Mr. H. G. Pudney, to the Agricultural Department of Nigeria.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :— A full-time assistant for the engineering department of the West Hartlepool Technical College—The Secretary, Education Offices, West Hartlepool (Aug. 20). An assistant lecturer in the department of zoology of the University of Leeds—The Registrar, The University, Leeds (Aug. 27). A woman demonstrator and assistant lecturer in the department of chemistry of the Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (Aug. 30). An aircraft and engine inspector under the Government of India—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor-gardens, S.W.1 (Sept. 1). The Maybury (part-time) professorship of highway engineering at the City and Guilds College—The Academic Registrar, University of London, S.W.7 (Sept. 11). A general secretary of the Society of Chemical Industry who shall also have the position of general manager of the society's affairs—The President, Society of Chemical Industry, Central House, Finsbury Square, E.C.2 (Oct. 11). A Macleay bacteriologist of the Linnean Society of New South Wales—The Secretary, Linnean Society of New South Wales, 16 College Street, Sydney, N.S.W. (Nov. 30). A science master, with special qualifications in chemistry and qualifications in metallurgy desirable, at the Scunthorpe Modern School and Technical School—H. S. McIntosh, 14 Wells-street, Scunthorpe, Lincs. A petroleum chemist for Silvertown Lubricants, Ltd.—The Chief Chemist, Silvertown Lubricants Limited, Silvertown, E.16. A lecturer to deal with farm engineering and estate management subjects at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Shropshire. A junior assistant for a Government establishment—The Commandant, Experimental Station, Porton, Wilts. A junior chemical assistant in the Laboratories of the Research Association of British Flour-Millers—The Director of Research, Research Association of British Flour-Millers, St. Albans. Two junior assistants under the directorate of Ballistics Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

THE SPECTRUM OF MIRA CETI.—In 1924 the maximum magnitude reached by Mira was exceptionally low, and on that occasion some new bands hitherto unknown in stellar spectra were noticed in its spectrum by Dr. A. H. Joy. The origin of these bands is discussed in the *Monthly Notices of the Royal Astronomical Society* for June by Mr. F. E. Baxandall, who attributes them to aluminium oxide. They were treated by Dr. Joy as wide, bright lines, and he gave the wave-length measurements of their centres. By correcting these wave-lengths to the junction of the bright and dark regions, Baxandall has produced evidence which appears to be conclusive that the origin is to be found in aluminium oxide. Some enlarged spectra of Mira, accompanied by laboratory spectra of aluminium oxide as comparisons, show striking agreements of stellar bands with those of aluminium. A further examination of other spectra of Mira shows that aluminium oxide bands are probably normally present, and that all recorded bands other than those of titanium oxide may be attributed to this source.

INTERSTELLAR CALCIUM.—The problem of 'stationary' calcium lines in stellar spectra still presents difficulties in the way of an adequate explanation; but the recent work of Dr. Otto Struve has helped considerably to reduce these difficulties. In a paper in the *Astrophysical Journal*, vol. 67, p. 353, Dr. Struve gives the results of intensity measures of non-stellar Ca lines in 2056 stars (mostly of early spectral type). He finds that there is a marked increase in the intensity of the detached [K] line for fainter stars and for earlier spectral types, though there is no evidence of any such relation with luminosity. After a thorough examination of the data for possible sources of error, he shows that the intensity of the detached Ca lines is a function of the distance. This is in accordance with Prof. Eddington's theory of a large calcium cloud diffused throughout space (as opposed to localised clouds)—a theory which is becoming increasingly favoured. In explanation of the objection that detached Ca lines have not been found in stars of type later than B3, Dr. Struve suggests the comparative nearness of most of the late-type stars examined and the difficulty of distinguishing a blend of the true stellar line with the detached line. In the case of Novæ, which are usually admitted to be of very small parallax and in which the radial velocities are so great as to separate these two components with ease, the detached Ca has been found to be of great strength.

Research Items.

Beth-Phelet.—The chief work in Palestine of the British School of Archæology in Egypt during the past season is described by Sir Flinders Petrie in *Ancient Egypt* for June. The expedition has been at work on Tell Fara, 9 miles south of Gerar and 18 miles from Gaza. The thickness of the stone walling showed its importance. Overlooking the chief water supply on the road to Egypt, it became a place of escape from the desert and from the Bedawy, as its name signifies. Last season's work reached as far as eighteenth-dynasty levels. Other levels remain for future excavation. The tombs, where most of the digging was done, go back through the Jewish occupation. It was probably the town of the Pelethites, David's bodyguard. The hill is accessible only on the west, where it was guarded by a brick wall of fifteen feet thick. The bricks are of the date of Rameses III. Towards the south there was a Jewish fort. In the plain to the north were the cemeteries. All had been attacked anciently; but one tomb held a bronze bed of Mesopotamian type and a silver bowl with a ladle, also of silver, of which the handle was a girl swimming. Many beads were found, and numerous scarabs indicated the Egyptian connexion. A bronze figure of a bear and a calendar board with pegs for thirty days were among the other objects found. Much pottery, including painted Philistine ware of the twentieth-twenty-first dynasties, was in perfect condition.

Solutrean Sculptures from La Charente.—In *L'Anthropologie*, t. 38, Nos. 1-2, Dr. Henri Martin continues his account of his discoveries in the cave in the Valley of the Roc in Charente from which were obtained the human remains of Chancelade type which he has recently described (See Nature, June 16, p. 963). The discovery of several engraved objects had led to an expectation of further and more developed signs of artistic activity. The investigations of last year produced definite evidence previously lacking of Solutrean sculpture in relief. A blast brought to light on the under part of a mass of rock resting on the archæological floor, some magnificent sculptures in relief of unquestionably Solutrean age, as is shown by objects in the hard breccia still adherent to the face of the block of stone. Five masses of rock, each with sculptures, were removed. On the first was the figure of a horse and of one of the Bovidae, the head of the latter being missing from the first but found on the second stone. Two other pieces of rock carried representations of the horse, each of about the size of a dog of medium proportions. On the last block were a number of sculptures which at first were scarcely distinguishable owing to adherent matter. On clearing the stone it was found to bear a number of carvings. These exhibit a number of peculiarities of design and technique, such as a clever utilisation of a boss of stone to secure the effect of relief. A human figure has a mass of hair, in the midst of which nose and eyes can just be discerned.

Evolution of the Human Foot.—A paper which appears in vol. 19 of *Contributions to Embryology*, (Publication No. 380, Carnegie Institution of Washington, D.C.), has a bearing on man's relationship to anthropoid apes. The author, Mr. William L. Straus, Jr., of Johns Hopkins University, has made an intensive study of the embryological changes undergone by the human foot, and finds clear evidence of its evolution from one which had been arboreal and prehensile. He finds that in the fœtus of the third month the great toe or hallux is "highly divergent, and somewhat opposable," and that the tarsus is short and the phalanges are long, as in all arboreal primates. He finds that at an early stage of development, primates have feet of a common type, and from this common type, specialised forms are produced by divergent growth. The foot of the human fœtus, "in many if not in most respects, is not unlike that possessed by the adult gorilla, although in some points even more primitive than that of the largest of the anthropoid apes."

Hensen's Node and the Origin of the Notochord.—In an important paper published in vol. 19 of *Contributions to Embryology* (Publication No. 380, Carnegie Institution of Washington, D.C.), Dr. George L. Streeter, Director of the Department of Embryology, Carnegie Institution of Washington, discusses certain fundamental problems relating to the growth of the early vertebrate embryo. He confirms the experimental observation made by the late Dr. Richard Assheton in 1896 that the first part of the vertebrate body to become differentiated on the embryonic shield is the mid part of the head, and from this initial area of differentiation the process of growth proceeds in a backward direction. Cervical, dorsal, lumbar, and sacral regions are thus progressively intercalated between the cephalic area and the anterior end of the primitive streak. He finds it advisable to recognise only two primary layers in the embryo, the ectoderm and entoderm, applying the term 'mesoblast' to the middle layer, which may be derived from either or from both of the primary layers. Hensen's node, which appears at the anterior end of the primitive streak, is a mass of mesoblast of ectodermal origin. Dr. Streeter finds that Hensen's node produces the notochord much in the same way as a seed produces a stem. The incorporation of the notochordal plate in the roof of the archenteron is a secondary phenomenon.

Lobster Rearing in Norway.—A very interesting account of experiments in rearing lobsters is given by Mr. Alf Dannevig in his paper entitled "The Rearing of Lobster Larvæ at Flødevigen" (*Report on Norwegian Fisheries and Marine Investigations*, vol. 3, No. 9; 1928). These experiments have been going on for some years in the Flødevig Sea Fish Hatchery, and have now given very successful results. The following conditions are found to be obligatory: (1) quick renewal of the water, (2) cleanliness, (3) suitable food. Berried lobsters are placed in wooden boxes divided into compartments on a slight slope, so that there is a gentle flow of water from one to the other, the larvæ being collected in the last compartment with a silk bottom. Before the larvæ are hatched the lobsters are fed on fresh fish, and twice a week are lifted out and the compartments scrubbed. Whilst hatching her eggs the mother puts her head down and tail up, and sets up a current with her pleopods, so that the young are naturally whirled away to the surface, where they are caught by the current and carried down to the collecting box. For rearing, boxes of cement and iron are used, with special circulation directed in such a way that the water mass will circulate round a horizontal axis without forming eddies in the corners. The water is let out through celluloid filters. The boxes are divided so that there is a spare room for the larvæ when the main compartments are being cleaned, into which they are automatically carried by a special current at that time. These are cleaned (scrubbed) at least three times a week. The food previously given was *Cancer pagurus*, but supplies of this crab

failing, *Mytilus edulis* and boiled egg were tried, but without success. Finally, beef liver was given, with good results, the larvæ being fed every two hours day and night. From 160 berried lobsters nearly 200,000 larvæ were collected, out of which 154,455 were used for rearing experiments, the rest being liberated when hatched or preserved for investigations. Out of those used for rearing experiments, 21,290 were reared to the fourth (lobsterling) stage, and liberated into the sea. In the most successful experiments where liver was used as food, 25,110 larvæ gave 8087 lobsterlings.

THE IDENTIFICATION OF BRITISH CRABS.—No attempt has been made for many years to simplify the identification of British crabs, so that shore-collectors or workers at marine stations might be able easily and rapidly to determine their captures. A key provided by Michael Perkins (*Scottish Naturalist*, 1928, p. 53 and p. 87) provides by simple dichotomous characters such an aid. It follows the practice adopted by Mortensen in his recent work on British echinoderms, of including far more than the Brachyura which have actually been found within the British area. The lack of definite boundaries in a sea area and the possibility of invasion by individuals belonging to species outside but bordering the area, have led the author to include all the crabs which have been found in the north-east Atlantic from Gibraltar to the Arctic Circle. The British species, however, are specially indicated. The key, which has been constructed so far as possible on non-technical lines, should prove a boon to the shore naturalist.

INSECTS OF NEW YORK.—*Memoir* 101 (published January 1928) of the Cornell University Agricultural Experiment Station is a bulky publication of 1121 pages devoted to a list of the insects, spiders, and certain other allied groups found within the confines of New York State. In his introduction Mr. M. D. Leonard, the editor-in-chief, states that the memoir is the outcome of a project originated about twelve years ago by a committee of specialists, and we may add that all concerned in the production of this laborious and valuable catalogue must view its completion with evident satisfaction. Dr. W. T. M. Forbes contributes a general account of the faunal districts of the State and an elaborate map accompanies the memoir, which thereby enables the numerous localities quoted to be found. The list comprises 31 orders, 430 families, 4797 genera, and more than 16,000 species of insects, Arachnida, Chilopoda, and Diplopoda—no less than 15,449 of these species being insects. The different sections of the work are the result of the energies of more than 150 specialists and collectors, and under each species the known localities and dates of appearance are given wherever possible. In point of view of species the Coleoptera head the list with 4546 representatives, Diptera following second with 3615. Some orders such as the Thysanoptera, with only 77 species, are evidently, as yet, only but little worked out. It is difficult to estimate to what degree the list approximates to the actual number of existing species of the various groups dealt with. As is pointed out in the introduction, in many parts of the State but little collecting has yet been done, and it is not unlikely that more intensive observations will increase the total by at least 25 per cent.

WEST AMERICAN SPECIES OF THE GENUS *PHASIANELLA*.—A review of the West American species of the molluscan genus *Phasianella*, derived from a large number of sources, is presented by A. M. Strong (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 17). The author summarises the previous literature bearing on the subject and describes 11 species, of which one is supposed to be new, while one receives a new name. There is a plate of illustrations from photographs so taken by Dr. G. Dallas Hanna as to represent, he says, the true black and white values of the colours of the objects, which, alas, is not the same thing as a good coloured plate would have been.

NEW OLIGOCENE MOLLUSCA FROM MEXICO.—Mr. C. Wythe Cooke describes a series of fossil mollusca from the Alazan Clay at, and near, the type locality on Rio Buena Vista in Vera Cruz, Mexico (*Bull. U.S. Nat. Mus.*, vol. 73, art. 10). Although the Alazan Clay has hitherto been placed in the Upper Eocene, the author is convinced from a study of its molluscan fauna that it is of Vicksburg (Oligocene) age and doubtless equivalent to the Mint Spring Marl member of the Marianna limestone. Brief notes on the localities at which the fossils were obtained by Dr. T. Wayland Vaughan in November 1920, are followed by descriptions of 17 new species and one new genus, *Protonema*. These new forms are figured on two clear plates from retouched photographs.

ATMOSPHERIC POTENTIAL GRADIENT.—In No. 38 of the *Geophysical Memoirs of the Meteorological Office* (1928, London: H.M. Stationery Office. 1s. 6*d*. net) R. A. Watson discusses the "Electric Potential Gradient Measurements at Eskdalemuir, 1913–23," covering a complete sunspot period. The three parts of the memoir deal with the method of measurement, the potential gradient on quiet days, and the connexion between the wind and the potential gradient. In the second part it is shown that, contrary to L. A. Bauer's conclusion from the first eight years' data from Eskdalemuir, there is no significant indication of a connexion between sunspot numbers and the departure of the mean potential gradient in any month from its eleven-year mean for that month. The last part is an attempt to elucidate the close but intricate connexion of the potential gradient with purely local meteorological events. It is concluded that the gradient depends largely on the wind speed, high gradients being generally associated with light winds, and conversely; but though very high gradients never coincide with strong winds, low gradients sometimes occur with light winds. Special cases of this are considered in detail. A theory of the connexion between gradient and wind is outlined, and it is shown that neighbouring masses of air of different history may have very different electrical contents; one can in fact speak of 'electrical fronts' in the atmosphere by analogy with cold or polar fronts.

ROCKETS FOR UPPER AIR EXPLORATION.—The March issue of *L'Astronomie* is wholly devoted to an exposition by M. R. Esnault-Pelterie of his researches on the exploration of the upper atmosphere by means of rockets, and on the possibility of inter-planetary voyages in the same way. The matter was the subject of a lecture on June 8 of last year before the Société Astronomique de France, the president of which, General Ferrié, contributes a commendatory preface to the printed report. The subject, which M. Esnault-Pelterie has studied for twenty years, has also been independently investigated more recently by Oberth, Hohmann, Valier, and Goddard; the latter had in mind particularly the projection of a small mass of magnesium powder to the moon, and has made experiments on the propelling power of various explosives. M. Esnault-Pelterie considers the conditions of ejection, both neglecting and taking into account the resistance offered by the earth's atmo-

sphere. Like Goddard, he concludes that it is already practicable to send exploratory apparatus of small mass to heights of some hundreds of kilometres, but that it is not at present practicable to eject enclosures large enough to contain human beings, with all the necessaries for their existence on a journey outside the earth's region of attraction, together with a sufficient supply of the propellant explosive to ensure their safe return. One principal difficulty is that the necessary initial mass is so many times the 'useful' mass; the ratio is 300-600 for small 'useful' masses, and far greater for habitable projectiles. The power required consequently increases with enormous rapidity as the useful mass is raised.

TIME CONSTANTS OF BRANCHED CIRCUITS.—In the issue of the *Faraday House Journal* for the summer term, Dr. A. Russell extends the idea of the time constant T of a circuit of self inductance L and resistance R where $T=L/R$, to the general case in which there are n branches in parallel with self inductances L_{pp}, resistances R_p, and mutual inductances L_{pq}. The generalised time constant of the branch p is then

$$T_p = \frac{L_{1p}}{R_1} + \frac{L_2}{R_2} \qquad \frac{L_{np}}{R_n}$$

and the quantity of electricity prevented by induction from passing through the branch p during the growth of the current in that branch from zero to its final value $E/\Sigma(1/R)$ is $T_p E/R_p$. It will be seen that T_p may by suitable choice of the resistances be either positive, zero, or negative, and that the transient current in a branch may be made to reverse, a property which may be of use in radio telegraphic circuits.

ELECTRIC PROPULSION OF SHIPS.—In discussing the merits of the electric drive of the propellers on board ship, engineers have usually been content to give merely the relative efficiencies of the mechanical and electrical drive. The mechanical drive being some five per cent more efficient than the electrical, it is concluded that it is the best to use in all cases. In *World Power* for July, Mr. Regnauld points out that many other factors have to be taken into consideration. For example, the simplicity with which reversing and manœuvring can be effected in an electrically propelled ship is a very great advantage. In small craft like harbour tugs the entire operation of the propelling motors can be controlled from the bridge. This eliminates the risk of error and the time lag essential when dual control is employed. It is well known that in order to obtain the last knot to a vessel's speed it is necessary almost to double the propelling power. As the efficiency falls off rapidly with the load, the vessel is only running economically at her maximum speed. When electric propulsion is used and there are several turbo-alternators, then by shutting down some of them the remainder can run at maximum efficiency. It is significant that the P. and O. Company have recently placed an order for a 19,000-ton twin-screw passenger liner which will be equipped with electrical propelling machinery. The vessel will be employed on the London-Bombay mail service, for which two distinct speeds are required. From London to Marseilles, where the mails are taken on board, the speed is 16 knots. From Marseilles to Bombay it is 18 knots. The use of the electrical drive enables the maximum economy in fuel consumption to be obtained at both speeds. Another advantage of electricity is the superior economy with which the auxiliary machinery on board can be operated. On some types of ship, such as a refrigerated cargo boat, an oil tanker, or a dredger, the auxiliary load is appreciably in excess of that required for the propulsion of the ship. In this case the doubling of the size of the electric generators would increase their efficiency.

SELENIUM TETRAFLUORIDE.—By the action of fluorine on selenium Lebeau (1907) prepared two compounds, a gas, SeF_6, and a colourless liquid which he considered to be SeF_4. The composition of this liquid was not altogether certain, since it closely resembled the oxyfluoride $SeOF_2$, and the mixture $SeO_2 + 4HF$ in some of its properties. Selenium tetrafluoride has now been obtained by the interaction of selenium tetrachloride and silver fluoride and an account of its properties is given in the *Journal of the Chemical Society* for June by E. B. R. Prideaux and C. B. Cox. The tetrafluoride strongly attacks glass, but has practically no action on clean copper. It reacts directly with silicon and red phosphorus and is completely hydrolysed by water.

NEOCYANINE.—The cyanine group of dyes are remarkable for their properties as photographic sensitisers. The constitutions of fifteen of the sixteen types so far described are known, and in the *Journal of the Chemical Society* for June, F. M. Hamer gives an account of the properties and preparation of the remaining one, neocyanine, and suggests a formula and the probable mechanism of its formation. Three neocyanine dyes have been prepared, and each has a higher melting-point and smaller solubility than the corresponding 4 : 4′ carbocyanine kryptocyanine, indicating a greater molecular weight. This conclusion is further supported by the fact that the neocyanines sensitise further into the red than the kryptocyanines.

DETERIORATION OF STRUCTURES IN SEA WATER.—The eighth Interim Report of the Committee of the Institution of Civil Engineers on this subject has been issued by the Department of Scientific and Industrial Research (London: H.M.S.O.). In addition to the periodical examinations of immersed specimens, the report contains a final examination of the first series of specimens of iron and steel exposed at Halifax and at Auckland for five years. The series exposed at Plymouth and at Colombo for the same period have also been removed, but have not yet been reported on. In general, the agreement between the Halifax and Auckland series is good. There is little difference between wrought iron and mild steel, although the appearance of the bars after corrosion is, as might be expected, decidedly different, the fibrous structure of the wrought iron being strongly brought out. Bars which had the mill scale produced in manufacture left on the surface were found to be much less pitted than bars which had been cleaned, although the loss of weight was sometimes higher and sometimes lower. This fact emphasises, as the facts contained in previous reports have done, the comparative worthlessness of loss of weight tests, observations of the manner of corrosion being much more valuable. On the whole, the attention given to the mechanism of corrosion in the report is disappointing. In the light of modern knowledge as to the effects of differential aeration and other factors, a more scientific study of the observations should be possible. Moreover, conclusions based on comparisons between single bars are rarely trustworthy, the erratic nature of corrosion being well known. The most interesting fact among the observations on timber is the indifference of *Limnoria*, on account of the construction of its stomach, to arsenical poisons used to impregnate the wood, so that a means of defence against this destructive organism is still unknown.

The Growth of Vegetable Plankton in the Sea.

THE changes in the plankton and their relationship to chemical and physical factors has long been a subject of inquiry, which is now being actively prosecuted along several lines. At the moment of writing, two research vessels on cruises round the world are investigating the distribution of manurial salts in the ocean waters and their relation to the quantity of planktonic life; the *Meteor* expedition in the South Atlantic has collected numerous data, and investigations are in progress on the Norwegian coast, off Heligoland, in the English Channel, and will shortly be instituted on the Great Barrier Reef upon varying facets of the same question.

Until recently it was only in isolated cases that more than a general relationship has been made out, to be followed by a succession of further flowerings. Each outburst was accompanied by an increase in oxygen, a fall in carbon dioxide—lowering the hydrogen ion concentration—and a fall in phosphate content of the water in the upper layers. A noticeable lag occurs between the commencement of a flowering and a fall in phosphate, and was also apparent with the changes in oxygen and carbon dioxide content of the water.

It is remarkable that the April outburst dies away and a week elapses before the second outburst starts in May, although phosphate available for growth remained in the upper layers. Again, the paucity of diatoms from June 4 until June 29 is not accompanied by a complete lack of phosphate.

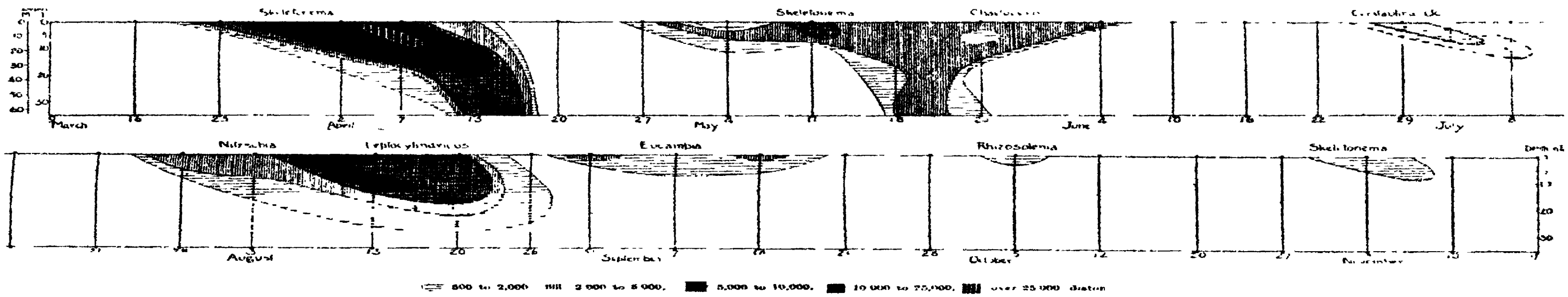

FIG. 1.—Diagram of the Diatoms at Clapochlar in 1926.

The work of Marshall and Orr[1] in Loch Striven, on the west coast of Scotland, during 1926 and previous years, has afforded a noteworthy addition to our knowledge of the physical and chemical conditions which accompany the outbursts of diatom growth in the sea—complementary to the work of Gran and his co-workers, and to that of Screiber, which were proceeding at the same time from a similar biological viewpoint.

Loch Striven lent itself readily to such an investigation, since it was found, from general surveys, that the outbursts of diatoms were similar in kind and in time to the outbursts in other positions in the Clyde sea area. The water is not polluted by any village on the shore, and the land area draining into it is only twice the area of the loch itself. The loch was visited weekly during 1926, when the diatoms occurring at various depths were ascertained, together with the phosphate, oxygen, and salt content of the water, its temperature and hydrogen ion concentration. Nitrate and nitrite were always found in the water, but the presence of iron oxide in the water, washed down from the hills, was thought to vitiate the method of nitrate analysis employed.

The successive growths or 'flowerings' of diatoms is clearly shown in Fig. 1. They commenced near the surface, extending into deeper water and then dying out,

[1] "The Relation of the Plankton to some Chemical and Physical Factors in the Clyde Sea Area," by S. M. Marshall and A. P. Orr. *Jour. Marine Biological Association*, vol. 14, pp. 837-868; 1927.

Provided there was also nitrate available for their growth, those intervals indicate that the diatoms require some other factor besides light and nutrient salts, or possibly that they excrete some substance inimical to their future growth, as was suggested by Nathansohn in 1909, but for which there is no definite evidence.

The succession of outbursts in the loch during summer are more numerous than the 'usual' outbursts in the open sea, and this is attributed to vertical mixing during the summer months, caused by strong winds blowing up or down the loch, and refreshing the phosphate-depleted upper water stratum.

Another point of difference from the open sea is that the spring outburst of diatoms has been shown to depend largely upon the amount of sunshine in the early part of the year in the English Channel and near the Isle of Man, whereas in Loch Striven during the years investigated it actually occurred latest in the year with most early sunshine.

Dinoflagellates occurred irregularly but were never numerous, except in the surface layers during the summer months, appearing and disappearing suddenly. They were most numerous near the head of the loch and their development was apparently related to changes in temperature and dilution with rainwater. They caused no noticeable change in carbon dioxide or oxygen content of the water.

H. W. H.

Wool and Wool Fibres.

RECENT activities of the British Research Association for the Woollen and Worsted Industries have included a visit by two members of its staff to certain of the textile centres of Belgium, France, and Germany. The Association has by this means endeavoured to secure first-hand information of the scientific work in connexion with wool and wool fibres which is being undertaken in those countries. It has also sought certain statistical information relating to the industry.

A report recently published by the Association gives an account of the institutions which were

visited and of the statistics which were obtained. The statistical portion of the report would lay no claim to completeness. Similar but more extensive information is included in the very useful appendices to the Survey of the Textile Industries published by Sir Arthur Balfour's Committee on Industry and Trade. Such statistical reports, in view of the somewhat meagre information which has hitherto been available, are of considerable value to the industry itself.

The report makes special reference to the work on the constitution of cellulose upon which Dr. R. O. Herzog and his colleagues are engaged at the Kaiser-Wilhelm-Institut für Faserstoffchemie, Berlin-Dahlem. Their work, which is based on the crystalloid theory of the structure of the wool fibre, has involved the considerable use of X-ray methods. The crystalloid theory of the wool fibre is not, of course, new. It does, however, provide a useful application of the relatively new conception of colloids of definite volume. Dr. Herzog gave a complete exposition of this work and of his own investigations in this connexion, at the spring conference of the Textile Institute, which was held in Cologne. A full account of the work appears in the *Journal of the Textile Institute*. Amongst other important investigations upon which Dr. Herzog is engaged, is the examination of the elastic properties of fibres. This work is of obvious importance to wool textile technologists.

Dr. Paul Krais, who directs the Deutsches Forschungsinstitut für Textilindustrie at Dresden, has devised an apparatus by means of which the evenness of stretch of fibres is being automatically recorded, apparently with rapidity and precision. He is also experimenting with a machine designed to measure felting properties. He appears to be able to secure that standard squares of cloth woven in different manner are subjected to uniform felting action under standardised conditions.

The portion of the report devoted to the activities at the Institut für Tierzucht at Hanover, and at Verviers and Roubaix, is likely to be of special interest to those actually engaged in the industry. At Hanover some three hundred students are being trained in animal husbandry under Dr. H. C. C. Kronacher, who is, of course, well known for his work on sheep breeding problems. At Roubaix and Tourcoing special attention is being given to the classing and sorting of wools. In its reference to this matter, the report contains the statement that the initial operation of wool sorting in England differs fundamentally in principle from that performed in France. In particular it asserts that " while in Bradford wool is sorted according to length of fibre, in Roubaix and Tourcoing it is sorted according to fineness." This statement appears to be misleading, as it does not represent entirely the current trade practice in Bradford wool-sorting warehouses.

The Association intends to continue the survey which it has initiated through these continental visits, by sending a member of its staff to Australia, New Zealand, South Africa, and Canada. The cost of this projected survey is to be met by the Empire Marketing Board, which has made a special grant of £2000 a year for two years to the Association. The survey is to include a study of sheep populations, of systems of management and marketing, of the relationship of wool to mutton production, of the distribution of breeds and types, and of the effect of climatic conditions and nutrition. The analysis of the various wools from the different colonies will form a complementary piece of work which will be undertaken in the laboratories of the Association.

The Fossil Redwoods of the Manchurian Coal Deposits.

IN recent issues of *Science News-letter*, issued by Science Service of Washington, D.C., Dr. R. W. Chaney discusses his discoveries of fossil redwood remains in the Manchurian coal deposits, and describes some investigations carried out in the arid region of the Gobi in Mongolia. It will be remembered that it was in this region that the expeditions of the American Museum of Natural History discovered the famous dinosaur eggs.

Dr. Chaney's investigations afford some light on the botanical and climatological conditions of the Gobi in geological times. He has been unable to find that the Gobi region has ever supported a rich forest of the Manchurian redwood type, or indeed any extensive forests at all. During the Cretaceous period, which was the time of the dinosaurs, the dominant trees were Araucarias, modern forms of which are known in cultivation as the monkey-puzzle tree, Norfolk Island pine, and by other names. They are now native only to lands in the southern hemisphere, especially in South America. The living Araucaria species all prefer cool, rather dry habitats, and independent geological evidence connected with the dinosaurs indicates that the Mongolian species of these great lizards were dry land, cool climate animals. Thus we have two lines of evidence that the Gobi of two million years ago was more or less like the Gobi of to-day; not so dry, perhaps, but certainly not a moist country, and subject to a rather cool climate.

Other fossils of a later date, the Tertiary, when the dinosaurs had become extinct, show that the Gobi had still much the same kind of climate. At present there are no trees at all in the Gobi proper, but in the canyons of the Altai Mountains, which extend out into it, there are numerous cotton-woods and shrubby junipers. These species, growing under conditions of low rainfall which make life possible for most woody growth, may be supposed to reflect the environment in Mongolia during the Tertiary, a suggestion which is amply supported by the associated fossil animals. These are almost entirely of types found in the plains, including none of the forest animals which should be preserved in the rocks had there been widespread forests in Mongolia during that period.

From the point of view of former tree distribution in Manchuria the work of Dr. Chaney unfolds a fascinating page. The forests that grow in northern California to-day, it is said, are so much like those Manchurian forests of millions of years ago that only an expert professional botanist could tell them apart. The track of the 'march of the redwoods,' as the author expresses it, was found associated with the great Manchurian coal deposits, some of which are already being worked. Mixed with the fossil records of the redwoods, though in far smaller amounts, were alder, oak, maple, and fern.

Dr. Chaney postulates the question: What was their line of march? Did they originate in the Old World and cross over to the New by way of the Bering Straits region, as the human race is assumed to have done? Or did they evolve first in America and go west until they reached Asia? He wisely refrains from giving an answer at present, until further research work has been undertaken in connexion with this absorbing problem. He refers to a hint, from the distribution map of the finds of redwood fossils, of a possible third alternative. These finds are spotted away up in the Arctic: in Spitsbergen, on the west coast of Greenland, on the waste tundras of northern Canada, and one find far up amongst those desolate islands north of Baffin Land

where Peary used to go when he turned his face towards the then unconquered Pole. Geologists have good evidence that these icy lands once had temperate climates, with at times even sub-tropic conditions. "May it not be that the nursery of the redwoods was in a lost polar paradise, now buried under the groaning glaciers of Greenland, or perhaps even sunk beneath the Arctic Ocean?"

Some idea of the climate of Manchuria of this geological period is obtained. The redwood fossils found were like the Californian coast redwoods, rather than the 'big trees' of the more inland mountains. The present Californian coastal forest enjoys an equable climate, without freezing temperatures, a rather humid atmosphere, and a rainfall of from forty to fifty inches, distributed fairly evenly throughout the year. This is a much milder climate than Manchuria has had during historic times, and probably than it has had since the Pleistocene, or glacial period. The existing Manchurian forests consist of oaks, maples, elms, and other species, but nothing resembling the redwood forests.

This investigation has opened up a most fascinating chapter in former tree distribution, and the results of Dr. Chaney's further researches will be awaited with interest.

Electrical Heating of Metals.

THE increasing interest which is being taken in electrical heating in connexion with heat-treatment of metals is exemplified by a pamphlet received from the Integra Co., Ltd., 183 Broad Street, Birmingham, as agents for the Leeds and Northrop Co., of Philadelphia, Pa., U.S.A. The necessity for the accurate heat treatment of expensive engineering steel parts is emphasised, the advantages of electric heating for this purpose, coupled with the exact control which is thus rendered possible, being probably ideal. The specific advantages possessed by electrical heating for hardening tools, dies, and similar articles are, in many cases, an increase of life due to accurate control of the time of heating and of the quenching temperature, reduction to a minimum of tools broken in the hardening and in distortion, and the possibility of treating the steel under conditions which do not lead to decarburisation. The equipment is flexible in the sense that it can be added to from time to time, and possesses the very marked industrial advantage that, since little heat escapes from the furnace into the room, the hardening plant can be put in the "line of production." The working conditions can also be made very much more pleasant than is often the case with other methods of heating. Electrical heating lends itself to accurate pyrometric, and often automatic, control, with a decrease in the amount of skilled labour required.

These advantages are possessed by Messrs. Leeds and Northrop's apparatus, but are, of course, inherent in electrical heating generally, when the apparatus is well designed, and are not possessed uniquely by the plant under review.

A pamphlet, also issued by the Leeds and Northrop Co., dealing with the electric furnace tempering of steel, describes their 'homo' furnace, which is suitable for the tempering of hardened steel parts. The outstanding feature of this apparatus is the reversible air current which is passed through the charge during the whole time that it is being heated up to the tempering temperature. The steel to be treated is contained in a basket which is lowered inside a cylindrical wall that forms the inner surface of the furnace. The basket is open at the top, and is closed at the lower end by a heavy grid. Below the basket is a fan driven by an external motor that reverses automatically, driving the heated air alternately up through the charge and down through an angular space between the basket and the wall of the furnace, and then in the opposite direction. Between the inner wall of the furnace, which closely surrounds the basket and the heavily insulated outer wall, is this air space in which the heating coils of nickel chromium wire are situated. A very uniform heating is claimed for the method, together with the impossibility of over-heating the charge in the basket.

The Relationship of Crop Yield and Weather.

IN the *Monthly Weather Review* for February last, Messrs. J. B. Kincer and W. A. Mattice give examples of the practical application of a method of showing the relationship between the yield of a crop and various meteorological factors affecting it during its period of growth. The figures relate to wheat in North Dakota and Ohio. The method may be described as a modification of ordinary partial correlation suitable to cases where so many factors are involved that full treatment by the ordinary methods of partial correlation would involve an excessive amount of computation. The final result takes the form of a regression equation between the yield x and a limited number of such weather factors as are found to have significant simple correlation with x. In each of the examples given these factors combined are equivalent to a single meteorological variable giving a correlation coefficient of 0·93 with x.

The method of calculation is as follows:

(1) Correlation coefficients are worked out between each weather factor and x. These are lettered in the order of their absolute magnitude, a being the largest.

(2) The partial correlation coefficient (or 'multiple coefficient' as it is called here) between a and x, eliminating the influence of b, is worked out, and similarly for c, d, e, etc.

(3) From the highest of these partial correlation coefficients the value of x for each year is computed from the appropriate regression equation.

(4) The quantity so obtained is designated a, and if we suppose that e is the weather factor that was eliminated in the partial regression equation, then e and a are not considered any further, the cycle of operations being repeated with a_2 in place of a, and the remaining factors b, c, d, f, etc.

(5) A fresh set of calculated values of x, arrived at from a_1 and another weather factor, give the values of the new quantity a_2, and, as before, another weather factor (c, say) drops out of the cycle, leaving a_3, b, d, f, etc.

(6) Up to a certain point the value of the highest partial correlation coefficient increases with each application of the process. When this point is reached a partial regression equation is formed involving the various factors used in the partial regression equations for a_1, a_2, a_3, etc., and the remaining factors are rejected.

The coefficients found indicate that about 86 per cent of the standard deviation of the yield is accounted for by the weather factors, which referred to temperature, sunshine, rainfall, and humidity, for the period April to July in the case of North Dakota, and late April to late September for Ohio. It is evident that the method may be applied to any variables, and could be used for forecasting. E. V. N.

University and Educational Intelligence.

CAMBRIDGE.—The abstracts of dissertations approved for the Ph.D., M.Sc., and M.Litt. degrees in Cambridge University for the year 1926–27 are interesting, if only for the light they cast on the use that is made of these junior research degrees to encourage research among the younger graduates of Cambridge and other Universities. The comparative abstention of the literary faculties remains as marked as before. Only 14 out of 55 degrees were awarded in the literary faculties and only 2 of these went to Cambridge graduates! Of the 41 science degrees, 15 were awarded to students trained wholly at Cambridge. The difference between different faculties is shown by the following figures for the different departments:—Physics 10, Mathematics 6, Biochemistry 5, Physiology 4, Botany 4, History 4, while Fine Arts, Music, Law, Moral Science, Geography, Architecture, and Anthropology are all unrepresented in the list. The difference is reflected also in the Colleges:—Trinity with 10, Emmanuel and Caius with 9 each, and St. John's with 7, head the list, while Magdalene, Pembroke, Peterhouse, Queens', St. Catherine's, Selwyn, and Trinity Hall are absent. Of the graduates educated elsewhere who came to Cambridge only for post-graduate work, 13 came from other Universities in England, 5 each from Canada and Scotland, 4 from India, 3 each from the United States and Wales, 2 each from Australia and Ireland, and 1 from New Zealand.

THE Trustees of the Ray Lankester Fund have appointed Mr. A. D. Hobson, of the Zoological Department in the University of Edinburgh, as Ray Lankester Investigator for the year 1928–1929.

THE fourteenth annual report of the Carnegie United Kingdom Trust contains little of outstanding interest. The policy of the Trust in respect of the Central Library for Students has, it is true, been endorsed by the Departmental Committee on Public Libraries, but so far the Treasury has not accepted the liability. Hence the future of the Central Library for Students still hangs in the balance. The reluctance of the Treasury is not without justification, for it is admitted in the report (p. 31) that it is impossible to estimate what the eventual cost of its administration will be. Our own view is that the matter is one for the county education authorities, and that the State contribution should be limited to a subsidy to the railways in return for reduced rates on the carriage of books. The growth of the Central Library for Students is slow, but the expenditure upon the 'outlier' libraries in former years is now bearing fruit. They supplied during the year 1927, 1361 volumes out of 1576 demanded. This is an astonishingly good result, and it is pleasant to think that it has been rendered possible by the re-organisation of the specialist libraries subsidised by the Trust. In the report for 1926 a new borough library policy was announced, which took the form of subsidising certain municipal libraries accepting the Trust's conditions. These generally involve the imposition of a higher library rate. The stimulus of the proffered grants appears to have been effective, for the boroughs competed keenly for the grants, and good results were obtained as a result of the improved conditions.

FROM the Universities Bureau of the British Empire we have received a report of the proceedings of the annual conference of the universities of Great Britain and Ireland, held this year at Liverpool on May 12. The only subject discussed was "The contribution of the universities to the preparation of teachers for their vocation," considered under the heads—What is the essential service which a university can render to the education of the intending teacher, and What should be the relation of universities to the specialised professional training of teachers. The discussion revealed striking diversities of opinion. Sir Charles Robertson (Birmingham) maintained that not merely should there be nothing vocational whatever in the degree courses of would-be teachers, but while studying for their degrees these aspirants should forget their intention to become teachers. Mr. Culverwell (Dublin), on the contrary, held that they should all along realise the bearing of the degree course on their future work, and Prof. Strong (Leeds) urged the institution of a degree course having a more definite relation to the work of teaching than any at present provided. Mrs. Simon (Manchester) proposed the abolition of university training departments, Prof. Nunn (London) that they should confine themselves to the field of adolescent education; whilst Mr. Boyd (Glasgow) upheld the Scottish ideal of a university degree course for every teacher, and suggested "a re-thinking of our training system along the lines of the medical analogy." There was a marked cleavage between the speakers who accepted and those who rejected this analogy between training for the medical profession and training for teaching. In answer to criticisms of the present system of training grants, Lord Eustace Percy said he would be glad to receive from any university a definite scheme for a change-over from a grant for intending teachers to something in the shape of an additional State scholarship scheme.

THE Carnegie Foundation for the Advancement of Teaching, which has recently published its twenty-second annual report, administers an endowment of more than thirty million dollars, devoted mainly to the provision of retiring allowances and pensions for members of the staffs of universities and colleges in the United States and Canada. The annual reports review not only the work of the Foundation, but also pension systems, in whatever part of the world, which throw light upon the problem of teachers' pensions. With twenty years of experience and research to guide them and give authority to their opinions, the trustees, who are wholly opposed to non-contributory systems, have been able to secure a fairly general recognition of a principle which is of great importance to the cause of academic freedom—the principle, namely, that the accumulation arising from the joint payments of the college and the teacher is not liable to forfeiture on migration to another college or on discontinuing college work altogether. During the year under review, the University of Alberta in Canada was admitted to the list of institutions associated with the Foundation—"in recognition of its remarkable development and unusual promise." The Foundation interests itself not only in questions connected with pensions, but also with fundamental educational problems, and especially questions concerning professional education. Its publications during the year included a bulletin, the result of a five-years' study in close co-operation with the professional associations concerned, on dental education in the United States and Canada. Commenting on this and on the unsatisfactory relations between the medical and dental schools, the former belittling the efforts of the latter, and the dental students receiving inadequate instruction in oral medicine, the report says that in the medical as in the dental curriculum there is need for a readjustment of medical teaching in the direction of greater simplicity and a more direct contact for the medical student with the hospital and with the patient.

Calendar of Customs and Festivals.

ADDENDA.

August 5.

Lammas Sunday. Garland Sunday.—In Ireland this is a survival of a pagan festival in honour of the earth about to yield up its fruits. The farmer feeds his family on the first fruits. No potatoes may be dug before this day and no flower or fruit placed on the altar. The day was also devoted to solemn rites in honour of the dead. A garland was decorated the night before with coloured ribbons. Early in the morning maidens gathered flowers to decorate the garland, but no married woman might either gather flowers or touch the garland lest it should wither and bring ill luck. The procession to the churchyard was headed by the finest young man of the village, who bore the garland. If any of the apples which hung on the garland fell while they were on the way to the churchyard, it portended prosperity and long life for the bearer. But if an apple fell after the garland had been hung up in or near the churchyard it brought bad luck to all who were dancing at the time.

August 15.

In the Highlands of Scotland the Assumption of the Virgin Mary marks the middle day of autumn; it is known as the Big St. Mary, and is held in even greater veneration than the Little St. Mary of spring. It also marks the height of harvest, for, as the popular saying has it, it is the time of "Harvest, sheaf and binding, and men with their coats off."

In Ireland the Assumption of the Virgin was one of the great festivals of the year and was observed from a remote antiquity. It was mentioned by Ængus in his compilation of the Irish Saints at the beginning of the ninth century. A curious and obscure note to the passage points to a tradition other than that of the Church. "Mary is called 'Mother of Mœlruain,' because Mœlruain was her doctor, or because she was Mœlruain's sister." Again it may be noted a remarkable association of a male character with the Virgin.

'Ladyday in Harvest' is in Ireland the time of fruitfulness. An ancient Irish quatrain refers to 'the apple soft and yellow,' 'the berry black on the branch,' and 'the bellowing of cows and calves.'

The pilgrimages to which the name of patron was given were numerous on this day, and the wells dedicated to the Virgin were many. At Agadha, near Cloyne, Co. Cork, the people assembled to perform their stations and pray in the middle of a marshy field. A solitary tree near the well was covered with pieces of cloth tied to the tree by the pilgrims who had benefited by the waters—the familiar form in which the pagan offering or sacrifice survives, especially at holy wells. A patron at Our Lady's Well at Ballyhea was, by the influence of the clergy, converted into a cattle-fair.

August 24.

St. Bartholomew's Day.—By an ancient custom of Croyland Abbey, little knives were given to all comers on St. Bartholomew's Day. In the north of England it was one of the days on which rush-bearing took place. At Dorrington, in Lincolnshire, a number of maidens went in procession to a chapel, where they strewed the floor with rushes and then went to a piece of ground known as the 'play-garths,' where they were followed by most of the inhabitants and the day spent in wrestling and other athletic sports.

In England, St. Bartholomew is perhaps most noted for the fair held for over seven centuries at Smithfield, London, until its abolition in 1855. It is said to have been constituted in 1133 by Henry I. as a grant to the monk Rahere, who had been his jester, and had founded the Priory of St. Bartholomew. It therefore was originally closely associated with the Church and was the occasion of the presentation of plays—mysteries, miracles, and moralities. It is to be noted, however, that traditionally the first proceedings of the fair after it had been opened by the Lord Mayor of London consisted of wrestling matches. After they were over, rabbits were let loose to be chased by the boys. Similar athletic sports, and especially wrestling matches, are the characteristic feature of the Lammas and other August celebrations, especially of the traditional type, of which some unquestionably go back to pagan times. The monastic character of the fair survived in the dialectical and grammatical disputations between the boys of the London schools which took place in the priory as recorded by Stow.

Many records, besides the famous 'Bartholomew Fair' of Ben Jonson, bear witness to the degeneration of the fair into a licence which led to its restriction to the original limit of three days, and its final abolition. Cases of dispute over debts and contracts and offences such as "slander of goods," which in the ordinary course would have been referred to the jurisdiction of the law, were settled within the fair by "the Court of Piepowders" held within the priory, and composed of a jury of traders formed on the spot, and the prior as president. Similar independence of jurisdiction within the fair is recorded in other cases. This is not entirely a privilege arising out of the ecclesiastical origin of the fair or its location on or within the bounds of church property—many fairs were held in churchyards—but is to be regarded rather as akin to the neutrality of the markets of primitive peoples. Where the trading is a by-product of a religious feast, the appeal to arms which in the ordinary course would settle a dispute between members of different tribes is taboo, and the sacred character of the occasion places it outside the usual jurisdiction. In Ireland, where the great national and provincial Games, such as the Tailltean Games revived in 1924, long antedate the introduction of Christianity, elaborate precautions were taken that the sacred peace of the Games should not be disturbed.

St. Ouen.—A saint of N. France, who attained high office under Clothaire and Dagobert I. and became archbishop of Normandy, the author of many miracles. His shrine at Rouen was sanctuary and on one day in each year it procured the pardon of one criminal condemned to death in the prisons of the city. The criminal touched the shrine and his pardon was immediate.

August 25.

St. Maelruba, Mourie or Moury.—The saint whose feast day in the ecclesiastical calendar falls on April 21 (*see* St. Maelrubius, Nature, April 14, p. 605) in Scotland was traditionally assigned a feast day on August 25. He has superseded a deity whose cult once extended over a wide area in the north of Scotland and culminated in a great festival in August. Both ritual and belief belonging to the earlier worship long survived in association with the saint. Down to A.D. 1678 bulls were sacrificed on this day on the island of Inis Maree, and milk was poured on hills as an offering. In the seventeenth century it is recorded that certain persons were indited for sacrificing a bull on the island of S. Rufus or Ellan Moury for the recovery of a woman from illness. Maelruba was frequently called the God Moury by the people of the area of which he was patron.

Societies and Academies.

LEEDS.

Philosophical and Literary Society, June 19.—**J. Ewles**: A torsion magnetometer. A new instrument for laboratory use based on the principle that the couple required to hold a magnet of moment M at right angles to a field H is MH. Magnetic forces are removed by balancing against the torsion in a phosphor bronze strip supporting the 'needle.' All the experiments usually performed with both the deflection and vibration magnetometers may be performed with this instrument.—**F. A. Long**: Note on the behaviour of a neon-tube under heavy discharge. When using a neon ('Osglim') lamp in parallel with the coils of an electromagnet, the discharge through the lamp on breaking the current was of bright bluish-violet colour instead of the usual pink glow, and included two or more flashes. An examination of current voltage during the discharge shows that at the commencement a current of several amperes passes, while the voltage falls much lower than the usual extinction value.—**C. W. Shoppee**: On the possibility of ring-chain valency tautomerism and of a type of mobile-hydrogen tautomerism analogous to the Wagner-Meerwein re-arrangement. Part 5: Pinacolic electron displacement as an explanation of various intramolecular transformations. A discussion and an attempted correlation of various intramolecular transformations on the basis of tautomeric change. The general mechanism proposed gives a satisfactory explanation of many known changes, and where divergences occur between theory and fact, reinvestigation confirms the theoretical prediction.—**L. R. Johnson** and **A. Wormall**: Potassium thiocyanate and the diastatic action of saliva and plant-diastases. Potassium thiocyanate exerts an activating influence on the diastatic action of human saliva, and this effect is significant, even with concentrations of the salt which may be present in the saliva. The thiocyanate appears to accelerate the first stages only in the hydrolysis of starch, and the rate of formation of reducing sugars is not markedly increased. The stimulating effect of this salt on the germination of potatoes and barley is discussed in relation to its influence on diastatic action.—**R. G. S. Hudson** and **F. W. Anderson**: On the Lower Carboniferous corals. *Hettonia fallax*, gen. et sp. n. The genus *Hettonia*, a member of the Clisiophyllidæ, is characterised by a solid central column built of an axial rod surrounded by tabular thickening. *Hettonia fallax*, the only species as yet described, is remarkable in that it possesses a distinct gerontic stage in which there is no columella, and therefore simulates *Caninia*. In addition, dedifferentiation is a common occurrence in this species. Certain new and undescribed structures are recognised in the ephebic stage of the corallite, and are attributed to calicular gemmation. The prototheca and part of the brephic structure are built while the young corallite is still attached to the parent individual, and remain there after separation of the young form.—**Lorna I. Scott** and **Ada B. Whitworth**: A structural peculiarity of the exodermis of the root of *Pelargonium*. In the root of *Pelargonium* the hypodermal cells develop a convex band of thickening, which runs round each cell on the radial and transverse walls. At maturity, the bands consist of lignified cellulose, with traces of silica, and show characteristic optical properties, which disappear on treatment with cellulose solvents.—**W. Garstang** and **Margery I. Platt**: On the asymmetry and closure of the endostyle in *Cyclosalpa pinnata*. The authors describe from sections the structure of the closed endostyle of *Cyclosalpa pinnata*. They confirm the absence of the left marginal band, and confirm it as due to the development of an interlocking mechanism by which the endostyle is firmly closed as a tube. The missing band, however, is present at both extremities with normal relations. The endostyle possesses a posterior growing point (cf. larval *Amphioxus*).

PARIS.

Academy of Sciences, June 25.—**Gabriel Bertrand** and **Georges Nitzberg**: α-Glucoheptulite. This alcohol is obtained by the action of reducing agents on α-glucoheptulose. It has the composition $C_7H_{16}O_7$ and is strongly lævorotatory. Details of the chemical and physical properties are given.—**J. Constantin**: Notes of Alpine pathology. Study of a parasite of *Picea excelsa*. The attack on the tree is more serious the greater the height above sea-level.—**A. Calmette**, **J. Valtis**, and **A. Lacomme**: New experimental researches on the tuberculous ultravirus. Proofs of the existence of tuberculous infection in infants of tubercular mothers. A distinction is drawn between true bacillar heredity, resulting from the direct transmission of the normal forms of the Koch bacillus, which is rare, and infection by the ultravirus, which is very frequent, and which does not appear to have grave consequences for the health of the infant provided the risk of reinfection is removed. Prophylactic measures suitable for the latter type of infection are suggested.—**André Blondel**: The yield of translucid diffusing globes and the principle of the conservation of the luminous flux.—**P. Helbronner**: The deviations from the vertical in Corsica.—**G. Friedel**: Remarks on a memoir of W. G. Burgers on uniaxial crystals possessing rotatory power.—**Edmund Wilson** was elected a Foreign Associate in the place of the late M. Lorentz: **Frédéric Swarts** was elected Correspondant for the section of chemistry.—**R. Coenen**: Isothermal surfaces.—**G. Vranceanu**: The absolute differential calculus of congruences.—**Alfred Rosenblatt**: The conditions of unicity of a solution of ordinary differential equations.—**Miécislas Biernacki**: Suites of holomorph functions.—**V. A. Kostitzin**: An integro-differential equation.—**Raphaël Salem**: The determination of the order of magnitude at the origin of certain trigonometrical series.—**André Roussel**: A pseudo-differential of a function.—**Alexandre Ghika**: The square functions capable of summation along the contours of their domains of holomorphism.—**R. Tambs Lyche**: The convergence of the series $\sum_{r=0}^{\infty}\begin{bmatrix} x \\ r \end{bmatrix} z^r$.—**Nikola Obrechkoff**: The summation of Taylor's series on the contour of the polygon of summability by the method of M. Borel.—**Georges Valiron**: A generalisation of a theorem of M. Landau.—**E. Cartan**: Closed Riemann spaces admitting a transitive continued group of displacements.—**J. Haag**: The calculation of certain elastic deformations, with application to the inertia of spirals.—**Jean Baurand**: The determination of the profile of a circular wave of small amplitude at the surface of a liquid.—**Mme. E. Chandon**: The variation of the latitude of the Paris Observatory.—**A. Danjon**: The photometric study of Algol with the visual cat's-eye photometer. The results of the observations are shown graphically.—**P. Lejay**: A method of recording the oscillations of a free pendulum and its applications to measurements of gravity. A modification of a method making use of Hertzian waves described in a previous communication. With photographic

oscillographs it is possible to read the record to 0·0001 second.—**Marcel Chopin**: A new method for measuring the temperature of a gas. The readings of a thermometer or a thermo-couple placed in a gas in motion are not exact owing to the radiation from the surrounding walls, the resulting error being considerable at high temperatures. The method proposed is based on the known relation between the weight of gas which passes through an orifice in a thin wall, the section of the orifice, the difference of pressure on the two sides of the wall, and the temperature. An outline is given of the application of this apparatus to the determination of the specific heat of gases at high temperatures.—**Emmanuel Dubois**: The Volta effect. From the experiments described it is concluded that water vapour plays an important part in the Volta effect.—**P. Daure**: Study of the secondary radiations observed in the molecular diffusion of light by fluids (the Raman effect).—**A. Blanc**: The photo-electric current as a function of the field in air at ordinary pressure.—**Mlle. C. Chamié**: The phenomenon of grouping of atoms for emanations and for mixtures of radioelements. The emanations of the radio-elements given out to the air or dissolved in mercury form groups of atoms. With mixtures of radio-elements heterogeneous groups are formed to a certain extent, but at the same time there are groups formed by members of the same family.—**A. Tian**: A reaction of double decomposition between saline vapours: fumes produced with gaseous salts.—**René Wurmser and Jean Geloso**: The limiting potential of solutions of glucides.—**Aubel and Bourguel**: The passage of pyruvic acid to alanine. A mixture of pyruvic acid and ammonia, in presence of colloidal palladium stabilised by starch, absorbs hydrogen very slowly: the completion of the reaction requires continuous shaking for six days. Pure alanine was extracted from the product of the reaction.—**E. Tassilly, A. Belot, and M. Descombes**: The use of solid caustic alkalies for the saponification of esters. The method detailed is shown to be of general application and is especially useful in the case of esters difficult to saponify or giving abnormal results by the ordinary method.—**Mme. Ramart-Lucas and F. Salmon-Legagneur**: The comparative stability of isomers according to their absorption spectra. Transpositions in the series of glycols and aldehydes.—**P. Brenans and Ch. Girod**: The triiodophenol obtained with the 5-iodo and 3·5-diiodosalicylic acids.—**Ch. Mauguin**: Study of the chlorites by means of the X-rays.—**E. Roch and C. Tingry**: The western termination of the Moroccan Haut-Atlas.—**Daniel Chalonge**: Study of the nocturnal variations of atmospheric ozone. The upper atmosphere does not contain less ozone at night than during the day. No seasonal variation was shown by the nocturnal proportion of ozone.—**Henryk Arctowski and Edward Stenz**: Study of the dusts which fell in the centre of Poland between April 26 and 28, 1928. Analyses of the dusts exclude the hypothesis of volcanic or Saharan origin and suggest that the dust came from Southern Russia.—**V. Hasenfratz and R. Sutra**: The immediate principles of the seeds of two species of Combretum.—**Philippe Fabre**: Chronaxy by cathode vacuum tubes.—**E. Huguenard and A. Magnan**: The production of electricity by the electric eel.—**Tahir Ertogroul**: The use of Wood's light for the early diagnosis of *grasserie* in silk worms. Silkworms in the early stages of this disease can be readily distinguished from healthy specimens under Wood's light.—**Paul Rossi**: Tuberculous ultravirus can exist in milk obtained from a tuberculous teat.—**Ch. Hruska**: The rôle of traumatism in the infection of the goat by anthrax through the alimentary canal.

Academy of Sciences, July 2.—**P. Helbronner**: Details concerning the measurement of the arc of the meridian in the French Alps.—**André Blondel**: A general method for measuring the absorption of a diffusor specimen.—**Pierre Weiss**: The specific heat of nickel above the Curie point. The atomic heat of nickel above the Curie point shows the same slow increase as copper. Their difference is constant and is equal to the part of the atomic heat corresponding to the kinetic energy of one degree of freedom.—**Léon Guillet, Galibourg, and Ballay**: The critical points and the martensitic tempering of nickel and nickel-chromium steel castings. A study of the changes in transformation temperatures produced by the addition of silicon, manganese, nickel, and chromium.—**Ch. Laforest-Duclos**: The prediction of cyclones in the Caribbean Sea and the Mexican Gulf.—**B. de Kerékjártó**: An elementary demonstration of the last theorem of Poincaré.—**Alfred Haar**: The unicity of solutions of partial differential equations.—**Hadamard**: Observations on the preceding communication.—**R. Guillery**: A recording manometer with a permanent control of its readings. The instrument described and indicated is designed to remove errors due to friction, can be altered in range by changing the spring, and can be easily calibrated.—**Th. de Donder**: Relativist thermodynamics of electromagnetic systems in motion.—**F. Pasteur**: The thermal utilisation of the solar radiation.—**Mario A. da Silva**: Electrons and positive ions in pure argon. From the experimental results given it is concluded that, within the limits of the sensibility of the measuring apparatus used, all the negative ions are electrons, starting with a mean effective field of 40 volts/cm.—**Mlle. Paule Collet and Francis Birch**: The paramagnetism of iron in potassium ferricyanide. For temperatures between 0° C. and 200° C., the atom of iron carries 12 magnetons.—**M. Ponte**: Absorption by excited mercury vapour and the reversal of the green line and its satellites.—**Edmond Rouelle**: A new category of ferro-magnetic frequency multipliers.—**C. Marie and P. Jacquet**: The hygroscopic and catalytic properties of electrolytic copper deposited in the presence of gelatine. These copper deposits contain small proportions of gelatine, copper sulphur, and water. Some peculiarities in the drying are detailed, and it is noted that the presence of these impurities confers catalytic properties on the copper, which, from the point of view of synthesis of water from hydrogen and oxygen, correspond with the action of finely divided copper reduced from the oxide at 220° C.—**Mme. Irène Curie and Frédéric Joliot**: The number of ions produced by the α-rays of radium C′ in air.—**Mlle. Jeanne Lévy and J. Sfiras**: The passage from a C_6 ring to a C_5 ring with molecular transposition by isomerisation of the oxides of phenylcyclohexene and of 1-phenyl-4-methyl-cyclohexene. The isomerisation of these compounds by distilling with a trace of anhydrous zinc chloride gives two isomeric oxygen products for each oxide. One is a ketone produced without molecular transposition, the other is an aldehyde containing the C_5 ring.—**Albin Marty**: The hydrogenation of the ether oxides.—**J. O. Haas and C. R. Hoffmann**: The geothermic situation of the petroleum bearing basin of Péchelbronn. A summary of the results of a series of thermometric determinations in the Péchelbronn oil region. It does not appear possible, as yet, to give a full explanation of the data. It is, however, certain that the rises of temperature cannot be explained by the presence of oil accumulations.—**Paul Corbin and Nicolas Oulianoff**: Contact metamorphism produced by the protogin of Mont Blanc.—**E. Rothé and Mme. A. Hée**: The magnetic properties of the stratigraphic

zones of the Rhine valley. The interpretation of the results of magnetic surveys requires a knowledge of the magnetic susceptibility of the underlying minerals, and these are frequently lacking. The magnetic susceptibility of over forty specimens from the Rhine valley are given.—**R. Esnault-Pelterie**: The law of the variation of the density of the atmosphere as a function of the height.—**M. Bridel, C. Charaux, and G. Rabate**: Ameliaroside, a new glucoside from the bark of *Amelanchier vulgaris*.—**Lucien Daniel**: The formation of thylles in grafted plants.—**Mme. L. Randoin and R. Lecoq**: The water soluble vitamines of group B. The probable existence of a thermostable and alkali stable factor necessary to life.—**Georges Bourguignon and André Walter**: Technical simplifications in the measurement of chronaxy in man with condensers. Description of the apparatus.—**A. Gourvitch**: Specific dynamic action in the cockroach.—**Marcel Avel**: Castration in Lumbricus does not prevent the evolution of the secondary sexual characters, anatomical and physiological.—**G. Guittonneau**: A spore-forming bacillus acting as a lactic ferment at high temperatures. No lactic organism hitherto described possesses a notable activity above 55° C. The organism now described, named *Thermobacillus tarbellicus*, multiplies most rapidly at 68° C., and survives exposure to a temperature of 100° C. for half an hour.—**G. Marinesco**: The rôle of autolysis in the pathogeny of Charcot's disease.

GENEVA.

Society of Physics and Natural History, May 24.—**Arnold Pictet and Mlle. Ferrero.** Heredity in the tufted guinea-pig. Dissociable conditional and localisation factors. The authors have proved the production of two types by crossing tufted guinea-pigs with smooth guinea-pigs. These types follow Mendel's law.—**R. Wavre**: The rigorous solution of the problem of figures of equilibrium. Starting with data more general than hitherto, the author gives a simpler demonstration of the impossibility of a distribution in homothetic surfaces of layers of equal density of a heterogeneous fluid in rotation.—**E. Rod and G. Tiercy**: Note on the rate of the chronometer *Nm* of the Observatory of Geneva. The authors have carried out a series of observations which show that the rate of this chronometer, during two months, remains between +1·01 seconds and +1·32 seconds. The pressure effect is normal: some anomalies appear to arise from accidental temperature variations.—**E. Joukowsky**: The cementation of the quaternary gravels. A working hypothesis. The author applies the well-known fact of the reduction in the solubility of calcium carbonate in the presence of carbon dioxide when the temperature is raised between 0° C. and 50° C., and admits that cold waters have, other conditions remaining the same, a greater incrusting power than warm waters. He shows that the cementation, in a given spot, in the peripheral portions of a glacier, should be stronger during its retreat than during its advance.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 7).—**N. G. Chetaiev**: The equations of Poincaré.—**A. Tsvetkov**: The spontaneous movements of *Paramecium caudatum*. Quantitative studies on movements of *Paramecium* show that the movements are due to some disturbances of intracellular chemical equilibrium.—**L. Berg**: The origin of northern elements in the fauna of the Caspian Sea. The Caspian fauna includes a series of northern forms, like *Stenodus leucichthys*, gull., *Limnocalanus grimaldi* de Guerne, *Chiridothea entomon caspia* Sars, etc. Hypotheses offered by previous authors are analysed, and it is concluded that these northern forms reached the Caspian Sea by way of the Volga, the basin of which has been, during the postglacial period, in connexion with a large lake basin adjoining the Baltic Sea.—**B. Gorodkov**: The work done by the expedition of the Academy to the sources of the River Gyda (Yenisseisk Province). A preliminary account of the expedition, which has done some geographical, botanical, zoological, and ethnographical work in the regions hitherto unexplored.

Comptes rendus, No. 8.—**K. Sapozhnikova**: Respiration of wheat seeds in ionised air. Results of the experiments indicate that ionised air exercised an inhibitory action on the respiration of seed, and the inhibition is due to the presence of free ions not only of oxygen, but also of nitrogen and of other gases of the air.—**S. Arcybyshev and J. Parfianovich**: The radio-activity of springs and minerals in the vicinity of the River Sludanka. Determinations of radioactivity of natural waters and minerals.—**K. Matvejev**: Tungsten deposits in the Southern Ural. A mineralogical and chemical study of the deposits.—**L. Sturm and T. Simakova**: Microbiological examination of some specimens of sulphur from the Crimea and Turkestan. Specimens of sulphur from various deposits showed different bacteriological characteristics. In some of these only bacteria oxidising sulphur were found; in others, desulphurating bacteria were also present.

SYDNEY.

Royal Society of New South Wales, June 6.—**A. R. Penfold**: The chemistry of Western Australian sandalwood oil (Part 1). Although it has been proved equivalent, if not superior, to the East Indian oil in pharmacology, the chemical composition of Australian sandalwood oil has been the subject of much controversy during recent years. It is very complex in composition, much more so than the East Indian. Various sesquiterpene alcohols, which constitute 95 per cent of the oil, have been identified and a simple colour reaction for distinguishing the two types of oils devised.

VIENNA.

Academy of Sciences, May 10.—**W. Leithe**: The natural rotation of polarised light by optically active bases (1). The influence of the solvent on the rotation of *d-a*-pipecolin and its chlorohydrate.—**K. Menger**: The metrics of Hilbert's space.—**O. Dischendorfer and E. Nesitka**: Nitrated *ms*-phenyl-dinaphtho-pyranes (3). Condensation of aldehydes with phenols.—**O. Richter**: Sodium, a necessary nutrient element for a marine aerophilic luminous bacterium. Sodium chloride has a double task, nutrient and osmotic. The minimum quantity of sodium chloride to be added to a stock solution of peptone and to fulfil both tasks is about 0·5 per cent, the maximum 5 per cent, the optimum 2·3 per cent. But other sodium salts or salts containing minute traces of sodium will do. Sodium is essential, sodium nitrate being the most effective sodium salt.

Official Publications Received.

BRITISH.

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 8. Pp. 187. (London: H. F. and G. Witherby.) 3s. 6d.

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 1, No. 1: The Igneous Intrusions between St. Andrews and Loch Leven. By Dr. Frederick Walker and John Irving. Pp. 17+1 plate. 2s. 6d. Vol. 56, Part 1, No. 2: Size in relation to Internal Morphology. No. 3: The Vascular System of Roots. By Dr. Claude W. Wardlaw. Pp. 19-55. 4s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 58, January to June, 1928. Pp. 303+24 plates. (London.) 15s. net.

Transactions of the Optical Society. Vol. 29, No. 4. Pp. 149-196. (London.) 10s.

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution. Report on Observations in the Year ending March 31st, 1927. Thirteenth Report. Pp. iv+54. (London: H.M. Stationery Office.) 6s. 6d. net.

Memoirs of the Geological Survey of India. Palaeontologia Indica. New Series. Vol. 10, Memoir No. 3: Les couches à *Cardita beaumonti*, Par Prof. Henri Douvillé. Pp. ii+25+4 planches. 2.12 rupees; 5s. Vol. 10, Memoir No. 4: A Supplement to the Mollusca of the Ranikot Series. By the late E. W. Vredenburg. Edited with Notes by Dr. G. de P. Cotter. Pp. iv+75+9 plates. 6.12 rupees; 11s. Vol. 11: Revisions of Indian Fossil Plants. Part 1: Coniferales (a. Impressions and Incrustations). By Prof. B. Sahni. Pp. iii+49+6 plates. 3.12 rupees; 6s. 6d. Vol. 12: The Fauna of the Agglomeratic Slate Series of Kashmir. By the late H. S. Bion. With an Introductory Chapter by C. S. Middlemiss. Pp. iv+42+8 plates. 6.8 rupees; 10s. 6d. Vol. 13: The Artiodactyla of the Eocene of Burma. By Dr. Guy E. Pilgrim. Pp. iii+39+4 plates. 3.12 rupees; 6s. 6d. (Calcutta: Government of India Central Publication Branch.)

Survey of India. Geodetic Report. Vol. 1, From 1st October 1922 to 30th September 1925. Pp. xii+323+16 plates. (Dehra Dun.) 6 rupees; 9s. 9d.

Department of Agriculture, Madras. Bulletin No. 89: The Conduct of Field Experiments. By R. O. Iliffe and B. Viswa Nath. Pp. vii+51. (Madras: Government Press.) 1.4 rupees.

Proceedings of the Royal Irish Academy. Vol. 38, Section A, No. 3: On the Motion of Vortices near a Circular Cylinder in a Stream of Liquid. By E. T. S. Walton. Pp. 29-39. 6d. Vol. 38, Section B, No. 7: Further Notes on the Metabolism of Conifer Leaves. By Prof. Joseph Doyle and Phyllis Clinch. Pp. 116-127. 6d. Vol. 38, Section B, No. 8: The Catalase Content of Conifer Leaves, with Notes on its Measurement. By Prof. Joseph Doyle and Phyllis Clinch. Pp. 128-147. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 4: Influence of Temperature on Response to Electrical Stimulation. By Prof. Henry H. Dixon and T. A. Bennet-Clark. Pp. 27-38. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate.) 1s.

Forest Bulletin No. 41: Note on Weights of Seeds. By S. H. Howard. Revised by H. G. Champion. Pp. ii+21. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10d.

British Mosquito Control Institute. Reports presented by the Council and the Director at the Second Annual General Meeting, held at the Hotel Cecil, London, June 18th, 1928. Pp. 16. (Hayling Island.)

Transactions of the Eastbourne Natural History, Photographic and Literary Society. Supplement, Vol. 9: The Butterflies of Eastbourne. By Robert Adkin. Pp. 61+15 plates. (Eastbourne.) 2s. 6d. net.

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Geological Maps: their History and Development, with special reference to Wales. By Dr. F. J. North. Pp. vi+133+12 plates. (Cardiff.) 1s.

Ministry of Agriculture and Fisheries. Miscellaneous Publications, No. 62: Report on the Occurrence of Insect Pests on Crops in England and Wales for the Years 1925, 1926 and 1927. Pp. 47. (London: H.M. Stationery Office.) 2s. net.

Review of Grapefruit Production in British Honduras. By Prof. H. Clark Powell. Pp. 23. (Belize, British Honduras: Government Printing Office.)

Ministry of Agriculture and Fisheries. Report on the Work of the Research and Education Division for the Year 1926-27. Pp. 87. (London: H.M. Stationery Office.) 2s. 6d. net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1149 (Ae. 316): Variable Density Wind Tunnel: Report of the Scale Effect Panel. (T. 2450.) Pp. 4+1 plate. 4d. net. No. 1152 (M. 55): Stresses in a Plate bounded by a Hyperbolic Cylinder. By A. A. Griffith. (E. F. 209.) Pp. 10. 9d. net. (London: H.M. Stationery Office.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Vincent, for the Year 1927. Pp. v+29. (Trinidad, B.W.I.) 6d.

Reports of the Imperial Economic Committee. Ninth Report: Tobacco. (Cmd. 3168.) Pp. 50. (London: H.M. Stationery Office.) 9d. net.

The Journal of the Municipal College of Technology, Manchester: a Record of Investigations undertaken by Members of the Manchester College of Technology. Vol. 13, 1927. Pp. vi+240. (Manchester.)

The Journal of the East Africa and Uganda Natural History Society. No. 31-32, October 1927–January 1928. Pp. 111-180+37 plates. (Nairobi.) 7s. 6d.; to non-Members, 15s.

The Cordwainers Technical College, Eagle Court, St. John's Lane, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture. Day and Evening Classes, Session 1928–9. Pp. 42. (London.)

Research Association of British Motor and Allied Manufacturers. Eighth Annual Report of the Council for the Year ending 31st March 1928. Pp. 8. (London.)

Broadcast English. 1: Recommendations to Announcers regarding certain Words of doubtful Pronunciation. Pp. 32. (London: British Broadcasting Corporation.)

FOREIGN.

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 2: Statistics of Nurse Training Schools, 1926–27. Pp. 57. (Washington, D.C.: Government Printing Office.) 10 cents.

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1922. Pp. xii+170. (Cairo: Government Publications Office.) 40 P.T.

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 6. Pp. iv+158. (Paris: Les Presses universitaires de France.)

Bernice P. Bishop Museum. Bulletin 45: The Ecology of an Hawaiian Coral Reef. By Charles Edward Edmondson. Pp. 64. 1 dollar. Bulletin 47: Land Snails from Hawaii, Christmas Island and Samoa. By Henry A. Pilsbry, C. Montague Cooke, Jr., and Marie C. Neal. Pp. ii+49. 1 dollar. Bulletin 49: Hawaiian Shallow Water Anthozoa. By Addison E. Verrill. Pp. 30+5 plates. 1 dollar. Memoirs, Vol. 9, No. 5: The Morioris. By H. D. Skinner and William Baucke. Pp. 44+8 plates. 2 dollars. (Honolulu, Hawaii.)

Department of Commerce: Bureau of Standards. Miscellaneous Publication No. 84: Standard Time Conversion Chart. Prepared by R. E. Gould. (Washington, D.C.: Government Printing Office.) 10 cents.

Publications of the Kapteyn Astronomical Laboratory at Groningen. No. 42: The Proper Motions of 2292 Stars derived from Plates taken at the Radcliffe Observatory. Measured and discussed by Prof. Dr. P. J. van Rhijn, Dr. W. J. Klein Wassink and B. J. Bok. Pp. iv+18+T25. (Groningen: Hoitsema Bros.)

Reports of the Imperial Industrial Research Institute, Osaka, Japan. Vol. 9, No. 3: Dispersoidological Investigations. 22: Jellies and Gelatinous Precipitates; their Classification, Conditions of Formation, Structure and Industrial Application. By Prof. Dr. P. P. von Weimarn and collaborators. Translated from the Russian by Mrs. P. P. von Weimarn. Pp. 196+12 plates. (Osaka and Tokyo: Koseikai Publishing Department.) 4.35 yen.

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 142: Tides and Currents in Boston Harbor. By Paul Schureman. Pp. iii+116. (Washington, D.C.: Government Printing Office.) 30 cents.

Reprint and Circular Series of the National Research Council. No. 81: First Report of the Committee on Photochemistry. Pp. 481-575. (Washington, D.C.: National Academy of Sciences.) 1 dollar.

Iowa Geological Survey. Vol. 32: Annual Reports, 1925 and 1926, with Accompanying Papers. Pp. 557. (Des Moines, Iowa.)

The Academy of Natural Sciences of Philadelphia. Special Publication No. 2: Crystallographic Tables for the Determination of Minerals. By Victor Goldschmidt and Samuel G. Gordon. Pp. 70. (Philadelphia, Pa.) 1.50 dollars.

Proceedings of the United States National Museum. Vol. 73, Art. 8: A Revision of the American Parasitic Flies belonging to the Genus Belvosia. By J. M. Aldrich. (No. 2729.) Pp. 45. Vol. 73, Art. 9: The Scorpions of the Western Part of the United States, with Notes on those occurring in Northern Mexico. By H. E. Ewing. (No. 2730.) Pp. 24+2 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 144: The American Bats of the Genera Myotis and Pizonyx. By Gerrit S. Miller, Jr., and Glover M. Allen. Pp. viii+218. (Washington, D.C.: Government Printing Office.) 55 cents.

Year Book, The Academy of Natural Sciences of Philadelphia, for the Year ending December 31, 1927. Pp. 106+9 plates. (Philadelphia, Pa.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 79, 1927. Pp. iii+334+229-583+26 plates. (Philadelphia, Pa.) 6.25 dollars.

American Institute of Weights and Measures: Scientific Papers, 4: Precision Value for the Inch. By Luther D. Burlingame. Pp. 9. (New York City.)

Bernice P. Bishop Museum. Bulletin 46: Tales and Poems of Tonga. By E. E. V. Collocott. Pp. 169. Bulletin 48: Ancient Tahiti. By Teuira Henry. Based on Material recorded by J. M. Orsmond. Pp. iv+viii+651. (Honolulu, Hawaii.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1557: Insects attacking the Peach in the South and how to Control Them. By Oliver I. Snapp. Pp. ii+42. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 73, Art. 5: Two common Species of Parasitic Crustacea (Sacculinidae) of the West Indies. By H. Boschma. (No. 2726.) Pp. 10. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 80. Mexican Mollusks. By Henry A. Pilsbry. Pp. 115-117. (Philadelphia, Pa.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 47: Rapport Jubilaire (1902-1927). Pp. iv+273. (Copenhague: Andr. Fred. Høst et fils.)

CATALOGUES.

British Chemical Balances and Weights. Pp. 24. (London: L. Oertling, Ltd.)

Electro-Medical Apparatus. (Bulletin No. 99.) Pp. 60. (London: Watson and Sons (Electro-Medical), Ltd.)

Diary of Societies.

SATURDAY, AUGUST 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—Annual General Meeting.

CONGRESS.

AUGUST 20–25.

INTERNATIONAL CONGRESS AGAINST ALCOHOLISM (at Antwerp).—Sir Arthur Newsholme: The Alcohol Question and Social Hygiene.—Prof. Firket: The Concentration of Alcohol in the Blood and the Diagnosis of Drunkenness from the Medico-legal and Insurance Aspects.—Prof. Laitinen: Recent Experiments on Alcohol and Heredity.—Dr. Puusep: Changes in the Endocrine Glands in the Descendants of Alcoholics, the Endocrine Glands and Inebriety, the Permeability of the Meninges in Alcoholics, and the Excitability of the Cerebral Tissue in the Descendants of Alcoholics.—Prof. H. Emerson: Results of American Prohibition from the Hygienic Aspect.—Drs. Vervaeck and Meeus: Social Effects of the Belgian Liquor Law of 1919.—Dr. Dahlgren: Alcoholism in Russia.—Drs. Bellin du Coteau and Bergeron: Alcohol and Sport.

SATURDAY, AUGUST 25, 1928.

CONTENTS.

National and Local Taxation in Relation to Education and Research.

PREOCCUPIED as they are with the advance of culture, learning and new knowledge, it is not surprising that the governing bodies of the various higher educational and research institutions, learned and other societies devoted to the same cause, find little time to spare for the consideration of such subjects as taxation and rating reform. In all probability few, if any of them, have yet given any thought to the possibility of the application to such institutions of the proposals outlined by the Chancellor of the Exchequer, in opening this year's budget, for giving relief to the productive industries of Great Britain, or envisaged the activities for which they are responsible as the most important productive industry of all.

It would be a pity, however, if no advantage were taken of the opportunity which presents itself in connexion with the rating reform proposals of the Chancellor, to press for the inclusion of all educational institutions, except those carried on for private profit, among those properties which are to be relieved altogether from the payment of rates. There is every reason for their inclusion. In the first place, educational progress is the decisive factor in industrial progress. The revival of agriculture and the basic industries of the country will ultimately depend even more upon the application of new knowledge and the intelligence of the persons engaged in them than upon the measure of relief proposed by the Government. Secondly, it would save trouble and expense to the Government, to local governments, and to the institutions themselves.

The case of University College, London, may be regarded as typical. At present this institution pays rates in respect of its buildings to two local bodies, the St. Pancras Borough and the Holborn Borough. These boroughs remit a proportion of the rates collected to the London County Council and other statutory authorities. The London County Council makes a contribution towards the upkeep of University College, and the Government assists it also out of the annual grant put at the disposal of the University Grants Committee. It seems fairly clear that it would simplify matters if the Government, now that it is committed to the principle of relief of rates, applied it to such educational institutions. It is not improbable that the Government would welcome representations made to it with this end in view, for it is very much in earnest in trying to eliminate unnecessary

administrative expense in connexion with national and local taxation.

Now that the whole system of rating and apportionment of rates in Great Britain is to be thoroughly overhauled, the time seems opportune not only to give direct relief to universities and kindred institutions as regards local rates, but also to ask that a rate be levied by local authorities to be applied definitely to their upkeep. At present all local authorities in England are left free to decide for themselves what they will contribute out of local revenues for this purpose, either directly in the form of a grant to a particular institution, or indirectly by means of scholarships and maintenance grants to students, or in both these ways. But they are also free to decide to make no definite contribution at all. It is difficult to defend such a system, more particularly as nowadays, in theory at least, university education is within the reach of all who are able to prove they would benefit by it. It is no longer the prerogative of one class. One way of financing the universities to enable them to meet their ever-increasing responsibilities to the nation would be for the central government to exact a *per capita* contribution for the purpose from every local rating authority in the country.

Another question in connexion with taxation which has not been given the prominence it deserves, is raised by the recent judgment of Mr. Justice Rowlatt, sitting in the King's Bench Division, on the appeal of the Geologists' Association against the decision of the Inland Revenue Commissioners regarding its liability to income tax. Apparently the Geologists' Association based its claim to exemption from income tax on the ground that it was just as entitled to be regarded as a charitable institution within the meaning of the statute of Elizabeth, the criterion in these matters as regards income tax, as any educational institution in the country. The submission of the Inland Revenue Commissioners in disallowing the claim was that in their opinion " the main function of the Association is the combination of members for scientific purposes and mutual improvement and the giving and receiving of instruction among themselves, and without questioning that the studies pursued by the members tend to the increase of knowledge and indirectly to the promotion of education generally, as well as other objects of public utility," they held that the Association is not a body of persons established for charitable purposes only.

Mr. Justice Rowlatt upheld that adverse decision, although he stated that it was a case in which the commissioners could have decided in favour of the Association on the ground " that after all these people arranged for visitors or outsiders being taken in, they amalgamated their library with the University library, and they admitted learned bodies to their membership." If any further endorsement of the views expressed by the Inland Revenue Commissioners and the learned judge on the useful public work performed by the learned societies were required, we have only to refer to the recently published report of the Research Co-ordination Sub-Committee of the Civil Research Committee, wherein it is stated " the great bulk of scientific papers has in the past been published in the Proceedings and Transactions of the various learned societies and in the Technical Journals, and the whole of it has been undertaken at the charge of individual workers banded together for that purpose."

The Government has in small measure acknowledged the nation's indebtedness to the learned societies by sanctioning a yearly Treasury grant in aid of scientific publications—it will be remembered this grant was increased from £1000 to £2500 in 1924—using the Royal Society as the agency of distribution to the others. It is somewhat ironical to find another Government body disallowing their claim to enjoy the privileges granted to other educational institutions on the grounds that their contributions to knowledge are made voluntarily and almost entirely at their own expense.

Were the learned societies extremely wealthy bodies so that the total amount of revenue involved were at all considerable in amount, were any special concessions granted to them at all likely to create a precedent for other claims, we could perhaps appreciate the anxiety of the Inland Revenue Department in the matter. The amount involved is, however, trifling, and we can think of no other bodies in the country, outside the learned societies, performing the same or similar functions. It is true that the existing definition of a ' charity ' for income tax purposes is capable of various interpretations, but it is at least permissive, as the Royal Commission on the Income Tax which reported in 1920 took occasion to point out when suggesting the term ' charities ' should be specifically re-defined by Parliament. If there is difficulty in finding a definition at once inclusive and exclusive, that is to say, inclusive of those bodies we have in mind, but exclusive of societies whose main function is propaganda of extremely dubious educational value, we suggest it might be overcome by a schedule to the existing Acts, which could be made subject to revision from time to time.

It may be, of course, that the practicability of this suggestion was already considered before it was decided to test the legality of two typical societies' claims for relief of income tax, up to the Court of Appeal, at the expense of the Treasury. If the next appeal from Mr. Justice Rowlatt's decision be unsuccessful, presumably recourse will have to be made to the House of Lords. The costs of this would have to be borne by the societies concerned, with any assistance which might be forthcoming from other interested bodies. It may eventually be desirable, therefore, for the societies to make representations to the Chancellor of the Exchequer, or direct to Parliament, in order that the onus of responsibility of finding a formula of exemption from income tax satisfactory to the societies and to the Inland Revenue Commissioners be put upon the Law Officers of the Crown.

There is one feature in the present action between the Crown and the learned societies on the subject of income tax exemption against which protest should be made. Up to the time the test cases were decided upon in 1926, these bodies had their claims for remission of income tax granted. Since that year the Inland Revenue Commissioners have refused to pass their claims for repayment, although the test cases have not yet reached the Court of Appeal. We should have imagined that, pending the decision of the Appeal Court, claims for repayment would have been passed in accordance with established custom.

'Lloyd's.'

A History of Lloyd's: from the Founding of Lloyd's Coffee-house to the Present Day. By Charles Wright and C. Ernest Fayle. Published for the Corporation of Lloyd's. Pp. xxi + 475 + 42 plates. (London: Macmillan and Co., Ltd., 1928.) 25*s*. net.

LLOYD'S is one of those institutions which was never really founded but grew into being, and it did not become a corporate body until it had been a power in the land for many years. The person from whom it takes its name had little or no knowledge of underwriting and had no direct connexion with that business: he was, in fact, the keeper of a coffee-house first in Tower Street and then, from 1691, in Lombard Street in the days when coffee-houses were becoming convenient places for business men to discuss their affairs over such refreshment as the houses provided. It was natural that persons of like interest should haunt the same place, and Lloyd's Coffee-house was patronised chiefly by the city merchants interested in marine affairs and in the insurance of the risks connected with the sea. Edward Lloyd and his immediate successors catered for the wants of their patrons and issued a news-sheet giving useful information, and many years later (in 1734) Lloyd's List was established, and the authors state "there can be no reasonable doubt that it was the demand of the underwriters for shipping intelligence that led to its establishment." The Coffee-house arranged with the Post Office to be exempt from the then heavy charges for delivery of correspondence. So the connexion grew, and even the Admiralty gave information to the master of Lloyd's Coffee-house and sought and obtained information in return. From about 1760 a 'Register of Shipping' was kept, and this series of registers developed into Lloyd's Registry of Shipping, an institution independent of Lloyd's.

Apart altogether from Lloyd's Coffee-house, the merchants interested in underwriting had taken action when the formation of companies to undertake insurances was under discussion. 'Bubble companies and intrigue' is not an unfair description of company finance of 1720, and the arguments for the formation of insurance companies with a monopoly, and those urged against the proposal by the merchants, seem poor enough to-day. The result did not come from argument, but the two charter companies won their charters and their monopoly by an outrageous piece of bribery of the King himself. The monopoly given to the two companies did not prevent merchants or individuals from underwriting insurance, and probably helped the individuals engaged in underwriting by preventing the formation of a number of companies. Many years later Lloyd's produced arguments to prevent the formation of rivals to the two charter companies, and it was not until the days when free trade was the cry that new marine insurance offices were allowed to be formed.

If a fear for their pockets had encouraged merchants to take joint action with regard to the formation of companies, it was a wish for better attention and greater comfort that led to their action in 1764, when those who formerly frequented Lloyd's Coffee-house set up a new Lloyd's Coffee-house in rivalry, and later on, in 1773, took rooms for the new Lloyd's over the Royal Exchange. The management of the old coffee-house had apparently become slack during the ownership of

an absentee proprietor. The new place was still a coffee-house; refreshments were not confined to a particular class of merchants, and the master of the new house was entitled to profits from the business. As time went on, however, the underwriters gradually took an increasing interest in the affairs of the place: those duties of the master which were secretarial, were taken over in 1804 by John Bennett, jr., who was the first secretary of Lloyd's, and ultimately mastership of the coffee-house ceased. Lloyd's remained at the Royal Exchange, except for a short interval after the fire, until very recently, when the new building in Leadenhall Street became available.

Turning now to the work of Lloyd's, the volume before us is especially interesting in its treatment of the action taken by Lloyd's in connexion with losses by shipping in war time, and the attitude of the merchants and underwriters with regard to dealing with the enemy in the eighteenth century is attractive in its simplicity and thoroughly different from the attitude instilled into everybody between 1914 and 1919. The argument used was that "to carry on trade for the mutual benefit of both nations, is not aiding and assisting the enemy." Heavy premiums were charged for covering the risks, but to the credit of the underwriters the risks were covered, although the underwriters disliked it intensely when Rodney seized St. Eustatius in 1781 with accumulated stores valued at £3,000,000. Over and over again we read of difficult times and of a certain number of failures, but success emerges in the end. Unfortunately, statistical evidence, which one might hope to find with regard to marine insurance in the past, is lacking: in fact, there is little evidence about losses except such as relates to the attempts made to study the shipping losses in the revolutionary war. From a scientific point of view this is regrettable, but investigation of this kind is always difficult, and probably presents insuperable difficulty when risks are covered by individual underwriters.

Throughout the years to which the book relates the rate of loss must have varied between something very small and something which, if it had continued, would have spelt ruin to any underwriter: but anything like a true measure of the risks at any moment is, and apparently must be, lacking. Is it because such a measure is lacking that there are times when marine insurance has a bad spell and cannot make profits? Individual underwriters, possibly by an ingenious study of their own experience, succeed when some of their fellows are less successful. There is evidence in this book that sometimes in the past this actually happened, and it may be happening again at the present time, but whatever difficulties there may have been it is clear that originally minded men like John Angerstein, Brook Watson, Marryat, Cuthbert Heath, or even that strange person Richard Thornton, who would cover a shipment of gold of £250,000, were certain of success, which an average underwriter could neither expect nor deserve. The explanation of the continued success of Lloyd's is probably because there has always been a sufficient number of men of the calibre indicated. One cannot help feeling, however, in reading through the present book, that many of their corporate actions were taken late in the day and were almost forced upon the underwriters.

Many years ago the underwriters produced a form of policy which, as an example of draughtsmanship, would be almost impossible to defend, but it is still in use, and a better defence of its continued use than that given in the book before us is probably that it has been retained because of the innate conservatism of the underwriters on one hand and a belief in the integrity of the underwriters, rather than a trust of a legal document on the other. Again, it was not until 1870 that a compulsory deposit was made giving real security for underwriting contracts, but in one sense at any rate the security was there long before, and the London underwriters were universally trusted. Clearly, if they had not been trusted, it would have been impossible for Lloyd's to have grown from an unconnected group of merchants doing marine underwriting into the position that it holds to-day, with its reputation of being prepared to insure not only marine risks but also fire risks and air risks, and all sorts of miscellaneous risks as well.

It is appropriate that the history of Lloyd's should be written by Mr. Charles Wright, who probably knows more about the history of Lloyd's than anyone living, and by Mr. C. Ernest Fayle, to whom everybody interested in shipping is grateful for his share in the official history of the War, and the book they have produced is well worth reading. The authors have wisely avoided the temptation of giving unstinted praise to their subject, and they have steered a course between the dullness of a business history and the journalism of advertisement. The book is beautifully printed, and, being adorned with many illustrations, for which Mr. Emery Walker is responsible, praise of it on the artistic side is unnecessary and would almost be an impertinence.

Societies and Academies.

Paris.

Academy of Sciences, July 9.—**A. Cotton:** The large electromagnet of the Academy of Sciences. A full description with five illustrations of the giant electromagnet constructed at Bellevue, at the Office national des Recherches scientifiques et industrielles et des Inventions. The magnet has a total weight of 120 metric tons, of which 105 tons are iron and 6 tons copper. Preliminary measurements give 46,400 gauss as the strength of the magnetic field obtained. The cost of the instrument was defrayed by a grant of a million francs from the Pasteur Day fund.—**P. Helbronner:** The measurement of the arc of meridian in the French Alps.—**G. Nicoladzé:** The configurations of ordinary space.—**H. Jonas:** The transformation of the integral surfaces of the partial differential equation $s^2 - rt = (pq)^4$.—**de Possel:** The prolongation of Riemann surfaces.—**Henrik L. Selber:** The theorem of Picard.—**R. Tambs Lyche:** Limit functions.—**Pierre Dive:** The generalisation of Stokes's theorem on figures of equilibrium.—**S. Szczeniewski:** The reflection of the electrons. The results of the experiments described agree with those calculated from the formula of L. de Broglie.—**G. Landsberg and L. Mandelstam:** Some new facts relating to the diffusion of light in crystals.—**G. Simon:** The production of gratings by photography.—**Gaston Rapin:** The direct electrolytic preparation of potassium permanganate. The use of a silicon-manganese alloy as anode with solution of caustic alkali as electrolyte gives a good yield of permanganate.—**P. Bonèt-Maury:** The vaporisation of polonium in a vacuum. The polonium is condensed on copper plates cooled by liquid air: from 80 per cent to 88 per cent of the polonium volatilised is condensed on the copper.—**A. Boutaric and F. Banès:** The phenomena of dyeing colloidal granules. When certain sols (arsenic sulphide, ferric oxide, gold) are frozen, the particles separate in the form of small crystals without fixing the colouring matter mixed with the sol, but when after flocculation with an electrolyte the colouring matter has been fixed by the granules, a subsequent freezing does not cause a separation of the dye. The absorption of neutral red, Bismarck brown, and Congo red by colloids has been studied by means of the freezing method.—**Nathaniel Thon:** The influence of electrolytes on the velocity of cataphoresis and the relations between the electrokinetic potential and the electromotor potential of gold.—**Ch. Quillard:** Contribution to the study of the reactivity of combustibles. Method of measuring the velocity of propagation of the combustion. There appears to be no relation between the temperature of inflammation and the velocity of propagation of combustion.—**M. Brutzkus:** The synthesis of organic bodies and of ammonia starting with water gas, without the use of catalysts. A note on the changes produced by simple compression of a mixture of water gas and air.—**Mlle. Cécile Noir and Tchéng-Datchang:** The preparation of cyanogen in the wet way. The gas obtained by the interaction of solutions of copper sulphate and potassium cyanide consists of 78 per cent cyanogen, 1-2 per cent hydrogen cyanide, and 20 per cent carbon dioxide. Jacquemin's method for preparing cyanogen by oxidising cuprous cyanide with ferric chloride gives purer gas in quantitative yields.—**Mlle. Marthe Montagne:** New researches relative to the action of organo-magnesium derivatives on some fatty dialkylamides.—**Marius Séon:** Contribution to the study of the action of gaseous hydrobromic acid on the ether salts of organic acids at the ordinary pressure. On the basis of some experiments described the author gives R . CO . OR′ + HBr = R . CO . OH + R′Br as a general reaction, R being any monovalent radical, and R′ an alkyl group.—**J. Tomitch:** A series of lavas from southern Serbia.—**Y. Milon and L. Dangeard:** The importance of the phenomena of solifluction in Brittany during the Quaternary period. The phenomena of solifluction was observed by J. G. Andersson at Bear Island, and applied by him to explain the rivers of stones in the Falkland Isles.—Formations of similar origin are found in Brittany and Normandy: several examples are cited.—**Clémencet:** Researches on the development of the perithecium in the genus *Elaphomyces*.—**P. Milovidov:** The chemical constitution of the chondriosomes and the plasts in plants.—**Raymond-Hamet:** The identity of yohimbine and quebrachine. Fourneau and Page stated that yohimbine extracted by Spiegel from the bark of *Pausinystalia Johimbe* and quebrachine isolated by Hesse from the bark of *Aspidosperma Quebracho blanco* were identical. This conclusion has been criticised on several grounds. The author has prepared pure specimens from both sources and proves that yohimbine and quebrachine are both chemically and physiologically identical.—**Henri Marcelet:** The presence of a fatty acid, not hitherto observed, in a fish oil. This acid has been isolated from the saturated fatty acids of the oil of *Dorosoma rasus*, and has the composition $C_{17}H_{34}O_2$.—**Mme. L. Randoin and Mlle. A. Michaux:** The comparative variations in the amounts of water, fatty acids, and cholesterol in the liver and spleen of the normal guinea-pig, and in the guinea-pig submitted to a diet deprived of the antiscorbutic vitamin.—**A. Paillot:** The relative importance of the various factors contributing to limit the spreading of the *Pyralis* of maize in the east of France.—**Y. Manouélian and J. Viala:** Virulent neuroses and excretory canals of the salivary glands.—**S. I. Zlatogoroff:** The etiology of scarlet fever.

Cape Town.

Royal Society of South Africa, June 20.—**V. A. Wager:** The breeding habits and life history of some Transvaal amphibia. The hitherto unrecorded life history and breeding habits of *Hemisus marmoratum* are described. The frogs were found at Gravelotte, in north-eastern Transvaal, the most southern record at present known. The eggs are laid in small cavities under the surface of the bank of a pool and are looked after by the female until they are hatched. The female then digs a tunnel from the nest to the water, down which the young tadpoles wriggle in a mass. The young tadpoles have a peculiar method of respiration by means of blood vessels in close proximity to the skin on the under side of the body—no external gills being present. They are able to remain alive out of the water for as much as 18 days. The later brief stages of the tadpoles are described in detail. Also brief notes are given on *Phrynomerus bifasciatus* and on *Hyperolius marmoratus*.—**J. H. Power and W. Rose:** Notes on the habits and life histories of some Cape Peninsula Anura. The breeding habits and life histories of *Hyperolius horstockii* and *Arthroleptella lightfootii* are described. Nothing has been previously known of the life histories of either the genus *Hyperolius* or *Arthroleptella*. The metamorphosis of the small mountain toad, *Bufo rosei*, is also given.—**D. G. Steyn and M. Rindl:** The toxicity of the fruit of *Melia Azedarach* (Syringa berries). *Melia Azedarach*, a tree native to the Himalayan region, is widely planted as an ornamental tree. It is known in South Africa as Bessiboom, Sering or Syringa, and the drupes, known as Syringa berries, are commonly

believed to be toxic. The recorded information with regard to their toxicity, obtained from American, Australian, and South African sources, is conflicting. In view of the inconclusive nature of the recorded evidence it seemed desirable to reinvestigate the problem, both from the toxicological and chemical point of view. The results show that hogs, sheep, goats, rabbits, and guinea-pigs are susceptible to the syringa toxin, pigs being the most susceptible animals, and goats less so than sheep. Muscovy-ducks were not killed even by relatively high doses of the plant material. The symptoms produced in the fatal cases are paralysis and narcosis. Death usually occurs through suffocation. Cold alcohol completely removes the toxin from the ground fruit, but the product is contaminated with considerable quantities of innocuous resin. Continuous extraction with ether fails to remove the toxin completely. The toxins are not of the nature of alkaloids, toxalbumins, or glucosides easily hydrolysed by acids. They most probably belong to that indefinite group known as "bitter principles."—**Dr. Jan Dommisse**: Mean sea-level and other tidal phenomena in Table Bay. The paper is a brief summary of work on (1) mean sea-level at Cape Town, (2) correlation between mean sea-level and barometric pressure, (3) nineteen yearly tides, (4) special tidal phenomenon in February 1907, and (5) tide constants.—**Dr. F. G. Cawston**: The resistance of *Limnædiæ* to varying degrees of desiccation. The periodical drying of pools results in the death of those examples of the *Limnæidæ* which are stranded on the surface, as they are unprotected by an operculated shell; those that settle down into the mud are not affected by dry winds or the strong sun's rays, though they are still subject to the attacks of some of their natural enemies. *Physopsis* and *Bulinus* are better able than *Limnæa* to hibernate in mud, because of the protection afforded by their stouter shell and smaller aperture. With appropriate food *Planorbis pfeifferi* (Krauss), *Bulinus tropica* (Krauss), and *Melanoides tuberculatus* (Müller) have survived burying in garden soil for twelve days at a time, though all the *Limnææ* were dead. The extensive growth of *Eichcornia crassipes* (Pontedor) rapidly dries up a pool infested with *Limnæidæ*, and *Tephrosia* might be used to destroy fluke-infested species.—**D. Slome** and **L. Hogben**: Preliminary communication on the chromatic function in *Xenopus lævis*. The power of chromatic response is well developed in *Xenopus lævis*. Between 15° and 30° C. photic stimuli are the main agencies contributing to pigmentary effector activity. A statistical method of describing the extent of expansion or contraction of the dermal melanophores by assigning arbitrary numerical symbols was applied to the comparison of series of animals kept at different intensities of illumination with the field of vision defined by surfaces of different absorptive power. The results show: (*a*) that there is a slight degree of primary reactivity independent of the eyes, tending to greater expansion with greater illumination, (*b*) that there is a secondary and independent response for which the eyes are the receptor organs, (*c*) that the secondary response by contraction in a light-scattering and expansion to a light-absorbing surface is of much greater extent and requires a lower intensity of illumination than the primary response, (*d*) that the melanophores of eyeless toads or of normal toads kept for some time in darkness are intermediate in condition.

Leningrad.

Academy of Sciences (*Comptes rendus*, No. 9).—**F. Levinson-Lessing**: Some controversial problems in the classification and nomenclature of rocks. Keratophyric rocks in the broad sense of the term must be regarded as leucocratic palæotypic (diagnetised) soda rocks (in some cases also potash rocks). They are subdivided into keratophyres proper, oxykeratophytes, and quartz keratophyres, as well as keratophyrites, oxykeratophyrites, and quartz keratophyrites.—**A. Tolmachev**: Lower Yenisei as a phyto-geographical boundary. The Yenisei valley is considered by many biogeographers as a boundary between the two great divisions of the Palæarctic region, one corresponding to the ancient Angara continent, and the other comprising the West Siberian lowlands. The distribution of plants in the northern parts of Siberia indicates, however, that the actual boundary between the two floras does not coincide with the geological boundary, but passes distinctly westwards from the lower Yenisei. This is explained by recent expansion of the Angara flora westwards, and a general principle is advanced, that biogeographical boundaries do not necessarily coincide with the geological ones, being dependent on recent migrations of organisms.—**A. Grosse**: Isolation of protactinium. Protactinium can be obtained in sufficient quantities by repeating many times the following processes: (1) protactinium, together with phosphates of zirconium and hafnium, is precipitated from the concentrated solution in hydrochloric acid; (2) phosphoric acid is separated from the phosphates of zirconium, hafnium, and protactinium by melting with potassium carbonate; (3) protactinium is isolated (though only partly) from zirconium and hafnium by the partial crystallisation of oxychlorides from the concentrated hydrochloric acid. In this way protactinium can be obtained as the oxide, Pa_2O_5.—**M. D. Zverev**: Bionomics of *Erythropus vespertinus* L. and *Hypotriorchis subbuteo* L. A pair of *E. vespertinus* has been observed on a nest with some young birds, which were fed by the old ones, but the young proved later to be those of *H. subbuteo*, and old birds of the latter species took care of them, while the pair of *E. vespertinus* disappeared.—**N. A. Kulik**: The sands of the Petchora region. These sands have definite characters showing their marine origin, and they have not been disturbed since their deposition; their age is that of the last regression of the northern ocean.

Comptes rendus, No. 10.—**P. P. Lazarev**: Some statistical problems concerning the movements of animals. While it is impossible to predict movements of individual infusoria, movements of a large number of them are subject to the same laws as movements of small inorganic particles.—**P. P. Lazarev, L. M. Couper**, and **A. Dubinskaja-Voskresenskaja**: The influence of age on the adaptation of peripheral vision. Visional adaptation has been studied in subjects of widely different age, from six to eighty-one years, and it was found that up to fifty years the power of adaptation is practically constant, but later it decreases rapidly.—**P. P. Lazarev**: A method for determination of the age limit in man. The age limit of man has been determined by a complete hardening of certain bones at about 130-150 years. The author suggests that age limit may be determined also by studying sensibility of centres of peripheral vision and of other nervous centres.—**P. P. Lazarev** and **A. Dubinskaja-Voskresenskaja**: Influence of alcohol on visual adaptation. Adaptability of vision is modified, but not essentially affected, by alcohol.—**Z. Sergeeva**: Respiratory organs of Isopoda. Preliminary report on the structure of the gills of *Porcellio lævis*, *Armadillium pallasi*, *Spæroma serratum*. Oxidising ferments in

the blood of the species studied have been proved microchemically.—V. Gromov : The age of palæolithic remains in Siberia. A classification of all known palæolithic remains in Siberia and an attempt to correlate them with the geological history of the country.

Comptes rendus, No. 11.—F. Loewinson-Lessing and A. Turcev : The magnetic properties of some stony meteorites. A number of meteorites were examined with regard to their magnetic condition, and it was found that, with the exception of two, all were feebly magnetised. A study of the artificial magnetisation of meteorites at different temperatures was also undertaken, with the result that between 400° and 500° C. a sharp increase in magnetism was observed.—D. Stcherbakov and A. F. Sosedko : Investigations of the 1927 expedition to South Forghana for the study of antimony and mercury deposits.—P. Kobeko and I. V. Kurtchaov : Formation of oxygen at the anode during the electrolysis of glass. The production of oxygen in the process of dissociation of glass by a current at different temperatures proves that Faraday's law is wholly applicable to the electrolysis of glass ; nevertheless, the use of the law is not justified in the case of an ionising current.—S. Kostychev and V. Faërmann : The fermentation of zymase is due to living cells. The fermentation of various samples of zymase proved to be a purely biological process due to the presence of yeast, while the presence of the hypothetical zymase could not be proved experimentally.—S. Kostychev and A. Chomitch : The absence of extracellular fermentation in the maceration juice of yeast. A series of careful experiments proved that the fermentation of the juice of macerated yeast is not due to the presence of zymase, but to a biological process, though the actual agent of the fermentation has not been yet found.

ROME.

Royal National Academy of the Lincei, Mar. 18.—E. Bianchi : Atmospheric extinction at Rome. The fact that Andrissi has recently obtained the value ·90 for the atmospheric extinction (ρ) at Rome, whereas the author found 1·02, is readily explainable, since the measurements were made in spring, summer, and autumn in the former case, and in the winter in the latter ; moreover, the zenithal distances were different in the two instances.—G. Abetti : Activity and altitude of the solar chromosphere in 1927. Combination of the results of measurements made at Madrid and at Arcetri in 1926 and 1927 gives, for the course of the altitude of the solar chromosphere, curves which are very similar for the two years, and confirms the general lowering in the latter year and the probable slight lowering at the poles ; a minimum at latitude 60° and a maximum at 30° are also well defined. Comparison of these curves with those indicating the areas of the protuberances deduced from measurements made at Arcetri shows that the maximum and minimum altitudes of the atmosphere, for both 1926 and 1927, correspond with the maximum and principal minimum of these areas observed at about the same latitudes. The general activity of the chromosphere, deduced from the total area of the protuberances based on the observations at Arcetri, is diminished by 250 units in passing from 1926 to 1927.—F. Zambonini and Silvia Restaino : Double sulphates of rare earth and alkali metals (11). Sulphates of cerium (cerous) and rubidium. Investigation of the isotherm for the system $Ce_2(SO_4)_3 - Rb_2SO_4 - H_2O$ at 25° reveals the existence only of the compound $Ce_2(SO_4)_3 . Rb_2SO_4 . 2H_2O$, which persists over a wide region of concentration. The 1 : 1 : 8 – compound, which is a usual type in this series, is formed under other conditions and has the specific gravity 2·954 and the crystallographic constants,

$$a : b : c = 0·8479 : 1 : 0·9181, \beta = 96° 7'.$$

The anhydrous compound, $Ce_2(SO_4)_3 , Rb_2SO_4$, is also described.—S. Franchi : The most suitable denomination and the cartography of the crystalline mass on which the city of Savona is partly founded.—A. Masotti : The conception of constant tensors in any variety. Considerations similar to those advanced by the author in a recent note on the equivalence of tensors, lead, when applied to Cisotti's views on the idea of constant tensors in Euclidean varieties, to the conclusion that a tensor should be regarded as constant in a field if its components may be made stationary in any point of the field by choosing Cartesian coordinates in that point.—S. Cherubino : Pseudo-normalising substitutions and normalisation in the general theory of real Abelian varieties.—P. Tortorici : A class of continuous functionals.—Maria Pastori : The geometrical significance of intrinsic derivation.—A. Colucci : The generalised second differential parameter.—A. de Mira Fernandes : Geodesic displacement, Riemannian curvature, and Bianchi's associated curvature.—C. Ferrari : The plane plate and the Kutta-Joukowski law. Cisotti has recently calculated the action of a plane irrotational current of density ρ and of asymptotic velocity c in the presence of a circumference C on a plane plate inclined at the angle β to the asymptotic direction of the velocity, by determining the pressures on the two opposite faces of the plate by means of Bernouilli's formula. The resulting force, which has the value $\rho c C \cos \beta$, is necessarily perpendicular to the plate and not to the velocity at infinity, as it would be in accordance with the Kutta-Joukowski theorem. Such exception is, however, only apparent and is a direct consequence of the method of calculation used, which does not take account of the pressure at the edges. At the extremities of the plate there is, indeed, infinite velocity and hence negative pressure, which is exerted on an infinitely small area, but has an infinite magnitude of the same order. There results a finite force which acts in the plane of the plate, and which, when combined with the normal force found by Cisotti, gives a resultant normal to the direction of the velocity of the current, as the Kutta-Joukowski theory requires. The proof of this has been given by Kutta for a circular wing and is now given for a plane wing.—V. Ronchi : Interference of corpuscular propagations. Interference phenomena, which have, up to the present time, furnished unshaken support to the classic theory of the propagation of light, are regarded as characteristic for undulatory propagations and as incompatible with any corpuscular theory. Propagation by means of corpuscles regularly distributed may exhibit phenomena comparable with those of stationary waves, and interference phenomena are not characteristic of undulatory propagation alone.—G. Malquori : The systems, $Pb(NO_3)_2 - LiNO_3 - H_2O$ and $Pb(NO_3)_2 - CsNO_3 - H_2O$ at 25°. Comparison of the results of investigation of these systems with those obtained by Gladstone and Saunders for the corresponding systems containing KNO_3 and $NaNO_3$ at different temperatures shows clearly that hydration of the alkali cations exerts distinct influence on the variations observed in the solubility of lead nitrate, the increase in this solubility increasing with the ionic radius of the cation. The fact that the increases in solubility are greater at the lower temperatures indicates the formation of complex compounds.—L. Fernandes :

Sulpho-salts (6). Molybdovanadothioaquates. Various compounds of the three types,

$$H_2\begin{matrix}(MoS_4)_4\\(VS_3)_2\end{matrix}\begin{matrix}(NH_4)_5\\H_2\end{matrix}\qquad H_2\begin{matrix}(MoS_4)_3\\(VS_3)_3\end{matrix}\Bigg]\begin{matrix}(NH_4)_5\\H_2\end{matrix}$$

$$H_2\begin{matrix}(MoS_4)_2\\(VS_3)_4\end{matrix}\begin{matrix}(NH_4)_5\\H\end{matrix}$$

are described.—**G. R. Levi** and **C. G. Fontana**: Precipitated zinc sulphide. The individual crystals of zinc sulphide precipitated in various ways are found to have similar dimensions, namely, about 20 A., which may be the dimensions of the pores of the filter-paper. The crystalline form of all the precipitates is that of zinc blende.—**G. Scagliarini** and **E. Brasi**: Additive compounds of halides of divalent metals and organic bases (6). Interaction of cadmium halides and hexamethylenetetramine in aqueous or acetone solution yields the compounds: $2CdCl_2.C_6H_{12}N_4$; $CdBr_2, 2C_6H_{12}N_4$; $CdI_2, 8H_2O, C_6H_{12}N_4$; $CdCl_2, C_6H_{12}N_4$; and $2CdI_2, C_6H_{12}N_4$.—**D. Cattaneo**: Ultramicroscopy of the crystalline lens (4). Modifications of the ultramicroscopic structure in the process of cataract. Cataract appears to consist in a passage from a homogeneous system to a heterogeneous system by precipitation, in the form of granules or droplets, of the proteins constituting the fundamental protoplasm.—**U. D'Ancona**: The possibility of arranging systematically the larval species of the Murenoids.—**A. de Lollis**: Modifications of the blood, hæmolymphatic apparatus, and kidneys in rabbits treated with transfusion of homogeneous blood.—**A. Galamini**: Investigations on the physiological action of alcohol. Action on the nitrogen exchange of albino rats fed with an insufficient subprotein, sublipinic, hypercarbohydrate diet (5). Alcohol exerts a favourable action on the resistance of albino rats on a diet of maize and varying proportions of beer yeast. This action does not consist in the conservation of protein substances, which are consumed in larger quantities when alcohol is administered.

Diary of Societies.

CONGRESSES.

AUGUST 30–SEPTEMBER 2.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Lausanne).

SEPTEMBER 3–10.

INTERNATIONAL CONGRESS OF MATHEMATICS (at Bologna).—In following sections:—Arithmetic, Algebra, Analysis; Geometry; Mechanics, Astronomy, Geodesy, Geophysics, Physical-mathematics, Theoretical Physics; Statistics, Mathematical Economics, Calculation of the Probabilities, Science of the Actuary; Engineering and Industrial Applications; Elementary Mathematics, Didactical Questions, Mathematical Logic; Philosophy, History of Mathematics.

SEPTEMBER 5–12.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Glasgow).

Wednesday, Sept. 5.

At 8.30 P.M.—

Inaugural General Meeting (in St. Andrew's Hall, Charing Cross).—Sir William Bragg: Modern Developments of the Physical Sciences and their Relation to National Problems (Presidential Address).

Thursday, Sept. 6.

At 10 A.M.—

Prof. E. C. C. Baly: Fluoresence, Phosphorescence, and Chemical Reaction (Presidential Address to Section B).

Prof. W. Garstang: Larval Forms: Their Origin and Evolutional History (Presidential Address to Section D).

Joint Discussion on Human Distributions in Scotland.

Prof. Dame Helen Gwynne-Vaughan: Sex and Nutrition in the Fungi (Presidential Address to Section K).

Dr. J. S. Gordon: The Livestock Industry and its Development (Presidential Address to Section M).

At 11 A.M.—

Prof. J. Brontë Gatenby, and others: Discussion on Cell Structures.

At 11.15 A.M.—

Dr. C. G. Simpson, and others: Discussion on the Mechanism of Thunderstorms.

Sir William Ellis, Col. Ivor Curtis, and others: Joint Discussion on School, University, and Practical Training in the Education of the Engineer.

At 12 NOON.—

Prof. J. L. Myres: Ancient Geography in Modern Educati (Presidential Address to Section E).

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

Dr. Vaughan Cornish, and others: Discussion on the Preservation of Scenic Beauty in Town and Country.

Friday, Sept. 7.

At 10 A.M.—

Dr. R. A. Sampson, and others: Discussion on the Photographic Measurement of Radiation.

Dr. J. Vargas Eyre, and others: Discussion on Fermentation.

Sir William Ellis: The Influence of Engineering on Civilisation (Presidential Address to Section G).

Dr. H. E. Magee, Prof. E. P. Cathcart, Capt. J. Golding, and Dr. N. C. Wright: Joint Discussion on Lactation and Nutritional Factors allied thereto.

Dr. Cyril Norwood: Education: the Next Steps (Presidential Address to Section L).

At 11 A.M.—

Prof. T. H. Pear: The Nature of Skill (Presidential Address to Section J).

Saturday, Sept. 8.

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. E. A. Westermarck: The Study of Popular Sayings (Frazer Lecture in Social Anthropology).

Sunday, Sept. 9.

At 11 A.M.—

Official Service in the Cathedral Church of St. Mungo. Preacher: Rev. Dr. Lachlan Maclean Watt.

Monday, Sept. 10.

At 10 A.M.—

Prof. A. W. Porter: The Volta Effect: Old and New Evidence (Presidential Address to Section A).

E. B. Bailey: The Palæozoic Mountain Systems of Europe and America (Presidential Address to Section C).

Prof. Allyn Young: Increasing Returns and Economic Progress (Presidential Address to Section F).

Sir George Macdonald: The Archæology of Scotland (Presidential Address to Section H).

At 11 A.M.—

Prof. C. Lovatt Evans: The Relation of Physiology to other Sciences (Presidential Address to Section I).

Prof. F. O. Bower, and others: Discussion on the Size Factor in Plant Morphology.

At 11.15 A.M.

Dr. H. H. Read, Dr. Gertrude Elles, and others: Discussion on Problems of Highland Geology.

At 11.30 A.M.—

Prof. T. H. Pear, Prof. H. Clay, and C. G. Renold: Joint Discussion on the Nature and Present Position of Skill in Industry.

Tuesday, Sept. 11.

At 10 A.M.—

Dr. C. J. Davisson, and others: Discussion on the Scattering of Electrons by Crystals.

Sir William Pope, and others: Discussion on Recent Advances in Stereo-chemistry

Prof. F. E. Suess, and others: Discussion on the Tectonics of Asia.

J. A. Venn, Dr. J. S. King, and others: Joint Discussion on the Incidence of Taxation in Agriculture.

G. E. Briggs, Dr. F. G. Gregory, and others: Discussion on the Interpretation of Growth Curves.

Aims of, and Developments in, Broadcasting. Papers:—(*a*) Sir John Reith: Wireless in the Service of Education. (*b*) Salter Davis: An Experiment in Educational Broadcasting.—Sir Oliver Lodge, W. A. Brockington: Discussion.

At 12 NOON.—

Prof. T. H. Mortensen, Dr. F. A. Bather, and others: Discussion on Bothriocidaris and the Ancestry of Echinoids.

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

At 2.15 A.M.—

Prof. F. E. Fritsch, R. Gurney, and others: Joint Discussion—A Biological Investigation of British Fresh Waters.

Dr. G. S. Carter: The Conditions of Life in a Tropical Swamp: an Investigation of the Swamps of the Paraguayan Chaco (Lantern Lecture).

At 2.30 P.M.—

Prof. E. Taylor-Jones: Spark Ignition (Lecture).

Dr. J. D. Sutherland, and others: Joint Discussion on the Economic Balance of Agriculture and Forestry.

At 2.45 P.M.—

Discussion on the Position of Geography in Scottish Schools.

At 5 P.M.—

Sir John Stirling-Maxwell, Bart.: Forestry in Scotland: Past, Present, and Future (Lecture).

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. F. G. Donnan: The Mystery of Life (Evening Discourse).

Wednesday, Sept. 12.

At 12 NOON.—

(In Bute Hall, University.) Concluding General Meeting.

SEPTEMBER 1, 1928.

CONTENTS.

Broadcasting and the School.

EDUCATION has a conservative and a progressive meaning. There are some who regard it mainly as a means for preserving civilisation, and there are others who would emphasise its function in preparing each generation to understand and to solve the problems of a more abundant and complicated world. The attainment of both aims is facilitated by the provision of apparatus, materials, and methods. Books, pictures, museums, laboratories, and workshops are available on a more lavish scale than ever before, and new devices for acquiring knowledge or skill are continually tested and applied.

Probably the most important educational experiment of the last ten years has been that of broadcasts to schools, and none has created more divergent opinions. On one hand, it has been hailed with enthusiasm as a means of widening the outlook and stimulating the interest of the pupils. On the other, it has been condemned as an unsuitable medium possessing no advantage over, and generally inferior to, personal instruction by a teacher. Both of these contain an element of truth. They are opinions which are based on objective and subjective facts. Objectively, the matter transmitted may be unsuitable, the speaker's method of delivery may be defective, reception may leave much to be desired. Subjectively, the teacher may belong to the group which welcomes external aid, or to the group which resents it.

The precise value and the limitations of the new medium in schools could only be ascertained by an investigation on scientific lines. A grant from the Carnegie United Kingdom Trust enabled such an investigation to be undertaken in Kent in 1927, and the report [1] which has now been issued is a remarkably interesting document. The schools were all elementary schools, and were selected in such a way as to represent a wide variety of conditions. They included boys', girls', and mixed schools, small rural, semi-rural, and large town schools. In regard to secondary schools and adult education, the experiments were only tentative, and are being continued.

The experiments were carefully planned. Each set lasted for a term. Three conferences were held, and these were attended by representatives of the teachers, of the Kent Education Committee, and of the B.B.C., and by H.M. Inspectors for the area. A 'Report Form' was sent out at the end of the

[1] "Educational Broadcasting," published by the Carnegie United Kingdom Trustees, Dunfermline, 1928.

first term; a '1st questionaire' at the end of the second term, and a '2nd questionaire' at the end of the third term. The questions varied with the course, and those in the second questionaire were varied slightly, as the result of experience or in view of the stage of the experiment, from those in the first. The answers were given in the form of 'Yes,' 'No,' or 'No information,' 'No opinion.' Great care was taken to avoid the answers 'Yes' or 'No' upon inadequate evidence or absence of conviction.

The chief positive value of the investigation lies in the gradual elimination of the objective imperfections which occur both at the transmission and reception ends. Much attention was devoted to the choice of subject, method of presentation, and voice and delivery of the lecturer, and it was found that a knowledge of school conditions and some experience in teaching were most desirable. No child will listen patiently to a speaker merely because he has attained distinction in some (to the child) remote sphere of intellectual activity. The lecturer must be an expert only in the sense that he can convey information or stimulate interest that cannot be obtained or aroused in the same degree by the ordinary methods in school. This means that he must know his subject, but it is more important that he should possess a transmittable voice and personality than that he should have made additions to knowledge. That is the blunt truth where young people are concerned. Older people will suffer much to feel themselves in touch with greatness. Young people will not; and the report wisely remarks that:

"A professor of mediaeval literature is called an expert: so is the driver of an express train. Sam Weller's knowledge of London was extensive and peculiar; he, too, was an expert."

At the receiving end it was found that possession of a good set was insufficient unless it was properly maintained. At the end of the first term, only 29 sets out of 44 were yielding good results. The B.B.C. then appointed two resident engineers at Maidstone and Canterbury, and made arrangements for technical assistance in other districts. At the beginning of the third term, 37 sets out of 55 were working satisfactorily, but by the end of the term only three were defective. It is interesting to note that in 17 out of the 18 sets not working properly at the beginning of the term, the fault lay in neglected batteries.

The subjective factor can never be eliminated entirely. However sympathetic a teacher may be towards wireless instruction, his interest in subjects is neither uniform nor universal. But by spreading the experiments over a number of subjects and a number of schools the differences probably cancel out; and by avoiding a 'forced' opinion for or against, the Committee obtained judgments which may be regarded as sufficiently detached to be of real value. The actual results upon the pupils are not measurable on any scale, and are rarely capable of expression in exact terms. They are opinions based on careful observation, and they are put forward in the report with so much moderation that they command respect.

The objective imperfections were so far reduced during the year that, in the case of some talks, the favourable opinion was almost unanimous. The general opinion of the teachers was

"That the Broadcast lessons (*a*) imparted a knowledge of facts; (*b*) stimulated interest in ways which could be definitely observed; (*c*) created impressions as durable as those produced by their ordinary lessons; (*d*) did not encourage inattention; (*e*) were particularly stimulating to clever children; (*f*) supplied views and information which the teachers themselves could not have supplied; (*g*) gave them fresh ideas for lessons; (*h*) interested some parents in the work that their children did in school."

On the other hand, "all the courses were not uniformly successful." The teacher should "have some knowledge of the subjects treated," and success depends very largely on "co-operation between the teacher and lecturer."

There is one aspect of school broadcasts that seems scarcely to have received sufficient attention. That is the influence on the teacher, and, through him, on the pupils. If the lecturer "supplied views and information which the teachers themselves could not have supplied," and if "he gave them fresh ideas for lessons," he is surely rendering a very direct service to formal education. It is relatively easy for the specialist teacher in a large urban school with a public library close at hand, to say contemptuously that he is in no need of external aid. But the case of a village school of forty children with two women teachers is different, and the danger that the teaching may become stereotyped and dull is greater. For this and other reasons we take the view that the greater part of the value of the radio lesson is indirect; that it operates, through the teacher, at times when the lecturer is silent and the voice of the loud speaker is stilled.

It will be obvious that the report is entirely favourable to school broadcasting, providing certain conditions are fulfilled. The practice has come into use, and it has come to stay. By August 1926,

before these experiments began, "nearly 2000 schools had notified the B.B.C. that they were making use of the school broadcasts." This tota has been reached in less than three years. The foreword to the report, which bears the signature of the director of educati— — — — — — — begins with these words :

"Every Monday afternoon at half-past two th Director-General of the British Broadcastin Corporation, after the manner of the well-know French Minister of Education, can take out hi watch and say: 'At this moment 70,000 childre are taking a wireless History lesson; Music o Tuesday, English on Wednesday, and so on throug the week.' Two years ago he could have claime 20,000 pupils. Two years hence he may be dealin with 200,000. In ten years, who can say ho many boys and girls will have come under hi influence?"

While declining the invitation to tread th perilous path of prophecy, we desire to congratulat those who undertook, or assisted in, the investiga tion on the accomplishment of a valuable piece c

The Structure of Mongolia.

Geology of Mongolia: a Reconnaissance Rep rt based on the Investigations of the Years 1922– 3. By Prof. Charles P. Berkey and Frederick . Morris. (Central Asiatic Expeditions: Natu al History of Central Asia, Vol. 2.) Pp. xxx + 475 + 44 plates + 6 maps. (New York: Americ n Museum of Natural History; G. P. Putna 's Sons, Ltd.; London: G. P. Putnam's Sc s, Ltd., 1927.) 10 dollars.

A GOBI, which according to Howorth is ne Mongol word for the stony or sandy des t, is explained by the authors of this monograph as an open plain on the floor of a basin. The geol y of the Gobis, in that sense, is rarely on first app r- ance attractive; but they often yield fossils of exceptional interest, because the remains of exti ct land animals have been buried in the deposits on their floors. Prof. H. F. Osborn made the so nd prediction that north central Asia would be fo nd to have been an important centre in the evolut on of the higher vertebrates, and an expedition o a grand scale was organised by Mr. Roy Andrew to collect the fossils which would be expected on his hypothesis. The expedition, as is well kno n, obtained a rich haul of fossil vertebrates—its m ost sensational discovery being the nests with the e ggs of dinosaurs.

This large and richly illustrated volume by P of. Berkey and Mr. F. K. Morris reports the results of the expedition in the field of stratigraphical geology. The palæontological collections are to be described in later volumes. The geological results are important, as they reveal the structure of a little-known part of east central Asia. The area explored is north-west of Peking from Kalgan across central Mongolia to Urga and to the south-west of that town. Most of the volume is occupied by the geological descriptions and sections of the long routes traversed by the expedition. These details are followed by general discussions of the geological results, of the geographical processes observed, and of the relations of the work to the geology of northern Asia.

Prof. Berkey and Mr. Morris have proved that the whole area rests on a platform of pre-Palæozoic rocks, which are divided into the three usual types : the lowest is a fundamental series of coarse gneisses, schists, and crystalline limestones, which in other parts of China is called the Tai Shan system; next is a series of quartzites, schists, phyllites, and limestones, similar to the rocks that in central China Bailey Willis called the Wu Tai system the third division, the Nankou system of Richthofen and the Sinian of Grabau, includes slates graywackes, and sandstones. This foundation wa invaded by a great mass of granite. Then followe a long gap, as the Lower and Middle Palæozoic which are well represented in southern China and Yunnan, are absent. The Carboniferous and Permian Systems are represented by marine deposits which were followed, after long interval, by a thic series of continental Jurassic deposits, which, lik the older rocks, have been folded. Then, afte another gap, occurs a long succession of Cretaceou and Kainozoic beds, which are all thin, are richl fossiliferous, and are nearly horizontal. Many o the fossils show that during their existence ther was an easy land passage between eastern Asi and western America.

The pre-Palæozoic platform is seamed with dykes but the later stages of central Mongolia contai only little evidence of volcanic activity. Wid sheets of basalt on its borders range in time fron the Lower Oligocene to the late Pliocene, and Mushketov has described a volcanic cone with a stil preserved crater. Messrs. Berkey and Morris dis covered some lavas and an interesting series c fused rocks near Mount Tuerin, which they describ as volcanic vents made by the fusion of the over lying sediments by superheated volcanic gase They describe these rocks as the most strikin experience of vulcanism seen in the Gobi regio

(p. 78). The fusion of surface clays would appear to require more intense heat than can be provided by a volcanic gas; and it may be due, like the pseudo-obsidians of India, to the burning at the surface of producer gas formed by the action of superheated water upon underground beds containing coal or bituminous material. The heat in this case may be due to dykes that fed the lava flows five miles from the locality.

The authors saw no local evidence of glacial action, and an interesting map (p. 383), that shows the very restricted range in Asia of the Pleistocene glaciation, forms a useful corrective to such views as that recently expressed in "Magic Ladakh," that a continuous ice cap spread from India to the North Pole.

The expedition found abundant evidence of striking earth movements. The numerous *talus* are described as warped basins. The Khingan Mountains, which form the eastern front of the plateau, are due to the subsidence of the land to the east, either by a down-fault or a down-fold along a monocline; and on the mountain types of this region fault action has been a powerful influence.

The authors classify the tectonic mountains of northern and central Asia into five series, and consider that the forces which raised them have acted in general along the same lines, and are due to one constant influence which has always been working in the same direction and in the main on the same mass of land. This view requires some qualification when applied to the Asiatic borderlands, but it appears to be true in the main for the interior of the continent; and the stress which the authors have laid on this conclusion should be very useful.

The basins, which are the characteristic features of Mongolia, are attributed to wind action, which lifts out of them the loose material; but the authors conclude that the wind has usually little power of direct erosion on rock. This conclusion is no doubt true where the process has proceeded so far that the country is smothered by a protective sheet of drift, as appears to be the case in central Mongolia; but where hard rock stands up in the way of the wind, other areas show that the wind may be a powerful agent of erosion. The authors remark that in Mongolia the cliffs are rarely undercut by the wind, and that their foot is generally protected by banks of earth. They therefore attribute the wide 'peneplanes,' for which they adopt that spelling, to the action of running water. The agency of the wind in the transport of material they recognise as of great importance; but the material carried they consider due to the disintegration of rock by weathering, and its destruction and scattering by running water.

One interesting chapter summarises the evidence of the changes of climate in Mongolia throughout geological time. The pre-Palæozoic rocks give no definite information, which is first afforded by the Permian marine rocks; they, by the absence of reef-yielding corals, denote a temperate climate. The evidence of the long succession of subsequent continental deposits indicates that the conditions have been generally those of a semi-arid land, which in consequence of its distance from the sea had a low rainfall. Some of the beds, such as the water-rolled conglomerates, required for their formation more powerful water action than the sub-aerial sands; but such different deposits may have been formed contemporaneously in the same region, one in river deltas, and the other on open plains. The only marked evidence of a change of climate appears to be in the Pleistocene, when during the glaciation of some parts of the world there must have been a heavier rainfall and more humid conditions, probably owing to the displacement of the track of the storms.

The volume is accompanied by a full bibliography. The work of the Russian explorers is illustrated by a map of their routes, which has been so much reduced that it is difficult to read. The illustrations are excellent, and on a most generous scale; they include some beautiful coloured plates of scenery after sketches by Mr. Morris. This work is the first issued volume of a series which will doubtless prove one of the standard authorities on the geology and natural history of Asia.

J. W. G.

Riddles in Evolution.

The Species Problem: an Introduction to the Study of Evolutionary Divergence in Natural Populations. By G. C. Robson. (Biological Monographs and Manuals, No. 8.) Pp. vii + 283. (Edinburgh and London: Oliver and Boyd, 1928.) 15*s*. net.

"We shall at least be freed from the vain search for the undiscovered and undiscoverable essence of the term species . . . a grand and almost untrodden field of enquiry will be opened, on the causes and laws of variation, on correlation, on the effects of use and disuse, on the direct action of external conditions. . . . A new variety reared by man will be a more important and interesting subject for study than one more species added to the infinitude of already recorded species."—Darwin, "Origin of Species"; 1884; chap. xv.

THESE passages from the master's eloquent recapitulation came irresistibly to mind on closing this book by the eminent authority on

mollusca of the British Museum. For in this excellent conspectus of "specialist and other data" on evolution we see how far we have trod the field these seventy years since Darwin.

The book has two parts; the first deals with the differences between species groups and the bearing of species recognition on evolutionary problems; the second mainly examines the existing 'orthodox' theories on evolutionary divergence. The point of view (Chap. i.) is that, despite all modern work on morphological, genetical, physiological, and ecological criteria, no essence of the term distils; further, that evolution does not imply the "production of standardised groups or units"; hence the title is a concession to the "time-honoured . . . convention that the initial stages of species-divergence are better studied in the form of taxonomic species," the latter having become the reference point at which most information concerning divergence is assembled. Chapter ii., on the constitution of species and natural populations, concerns species recognition, its difficulties, and the systematist's attitude. Physiological differentiation (Chap. iii.), though less canalised and more capricious in incidence and pace, "marches in a broad sense" with structural differences.

In Chap. iv., on allied species and their distribution, a new general principle, "Opportunity Dispersal," is briefly cited—a new species "as it arises may be compelled by competition to occupy a less-favoured or an unoccupied 'niche' . . . because other habitats are already occupied." In Chap. v. "Isolation" is lengthily treated, a special feature being a short review, very good, on sexual isolation. The importance of sterility is emphasised. Being restricted to promoting divergence, isolation is really of secondary importance, as it does not induce variation or promote the spread of variants.

Part 2 faces three problems: the origin of variant characters, their spread, and the origin of groups. The rôles of the germinal tissue, environment, and natural selection are ably reviewed, and careful attention is focused on correlation. The review gives us pause, for from all the post-Darwinian inquiry, unequivocal researches are rare. For example, concerning heritable variation, almost the only case is the melanism induced in moths by special feeding (Harrison and Garrett). Struck by the fewness of the individuals first responding to treatment, the author comments that coincidental conditions in the germ cells, *e.g.* physiological, may contribute to the changes invoked. Kammerer's early salamander work (Appendix) is not neglected, though it is regarded as showing only an accommodation or 'threshold' effect. Again, on the numerical increase of variants, we know little beyond the two cases of 'massive transformation' shown by Weldon's crabs and industrial melanism in lepidoptera; touching their spread, we know practically nothing. Natural selection, it is acknowledged, provides a logical explanation but is difficult to prove, though mimicry in lepidoptera appears a good example of its incidence. But of the many others usually educed (p. 212), only Weldon's experiments indicate that the death-rate works selectively so that the survivors are different from the eliminated.

Other difficulties, centred around the thorny problem of adaptation, are adumbrated and, incidentally, it is significant "that the selective value of slight differences between species and races has never been systematically explored." The special difficulties encountered in applying the orthodox evolutionary hypotheses in cases where groups are differentiated from each other in several characters highly correlated are stressed, the author feeling their importance because characters do tend to 'hang together' and because races and species are recognisable by this very tendency. Moreover, it is impossible to decide whether the production of non-serviceable differences between species has been due to correlation with serviceable ones because the evidence is deficient.

The book's format is good, but notice should be taken of a fair number of slips, *e.g.* Nuttal (pp. 66, 104, 105) for Nuttall, *Tephrosa* (p. 267) for *Tephrosia*, *menas* (p. 234) for *mænas*; several cross-references require correction—Lutz, 1909 (p. 28), is dated 1908 in the bibliography, and Viets, 1923 (p. 196), 1924, Bateson, 1912 (p. 78) is not given, and Myers and Gale (p. 187) reads Myers and Salt.

Whatever views one may hold on this or that theory of evolution—exponents of natural selection, for example, will not agree to the author's caution regarding its sweep—one must congratulate the writer on his informative, well-ordered presentation and its reasoning and reasonableness. The appeal of the book is to the worker in biology. It will be especially useful to promising senior students and 'improvers' for its point of view—that of an experienced worker impressed by the magnitude of the many problems and the smallness of the progress made. Such readers, too, will find a sane corrective to easy acceptance of 'royal road' theories and, no less, an incentive to work

in evolutionary problems, for the book is one long list of desiderata in this regard. It is a stock-taking that provokes heart-searching: Are our individual researches vested with sufficient universality?

We have a lurking doubt as to whether the biologist of to-day, despite the reaction towards studies in function, is intimate enough with living things. We suggest 'back to Darwin,' whereby, in one person or team, extensive field work, keen systematics, careful breeding, and inspired experiment are all laid under contribution in attacking the fundamental evolutionary problems appropriate to an organism or a group. Fortunately, to cite a few examples from Mr. Robson's book, important work on these broad lines is being wrought; Lotsy in Holland, Sumner in America, and Harrison in England are all engaged on 'new varieties reared by man' and fulfilling Darwin's prediction. But very many more such are needed, and more facts, and, above all, more time. After all, say for the spread of variants, what are the seventy post-Darwinian years compared with the ages available to Nature? A. D. P.

Historical Optics and the Microscope.

Origin and Development of the Microscope: as Illustrated by Catalogues of the Instruments and Accessories, in the Collections of the Royal Microscopical Society, together with Bibliographies of Original Authorities. Edited by Alfred N. Disney, in collaboration with Cyril F. Hill and Wilfred E. Watson Baker. Preceded by An Historical Survey on the early Progress of Optical Science, by the Editor. Pp. xi + 303 + 30 plates. (London: Royal Microscopical Society, 1928.) 17*s*. 6*d*.

FEW individuals possess all the qualifications necessary for the study of the history of any science. They must read with facility the Latin in which the ideas of the early writers were expressed. Failing actual possession, they must have ready access to the original works. Above all they must have the requisite leisure. These essential conditions are rarely found combined in one individual, and it is not surprising that familiarity with the scientific literature of the past is so limited. An impressive exhibit of ancient books at the recent Optical Convention attracted the casual attention of only a small proportion of the members, some of whom no doubt were interested more in the quaintness of the illustrations than in the matter. The collections of the various societies are rarely consulted, and private libraries are dispersed in the salerooms as no home of permanent usefulness can be found for them.

The three authors of this book combine all the qualifications requisite for the production of the historical work they have so successfully undertaken on behalf of the Royal Microscopical Society, of which they are fellows and honorary officers. Their work has been done in the most favourable surroundings directly within the valuable library and museum of the Society. Mr. Disney, the principal editor, states in the concluding paragraph of his preface that the work represents the labour of seven years. Anyone who has attempted to read one single work, such as the Thesaurus of Alhazen, will appreciate how much labour must have been involved in the concentration of twenty centuries within the limits of one concise volume.

Part I. contains four chapters of history and a bibliography, which in itself is a valuable contribution, comprising, as it does, many important extracts and interesting explanatory notes.

Chapter i. covers the period from the earliest times of Ptolemy, Euclid, Archimedes, and Hero to about the year 1590, when Baptista Porta was particularly active. In a future edition some rechecking of proofs will be required, particularly as regards the dates, which differ in the headings and text, due, in some cases, to the interchange of 0 and 6.

That optical instruments are erroneously attributed to the ancients forms the thesis of Chapter ii. Prominence is given to a very valuable discussion of this subject by Prof. Henri Martin, of the University of Rennes, in a paper which appears to be little known in Great Britain. While the authors have, in general, presented the views of the ancient writers they quote without any attempt to direct the opinion of the reader, they seemingly adopt the conclusion of Prof. Martin that the accomplishments of the past have been exaggerated. With that conclusion most people will agree, possibly with some regret that, in the case of Friar Bacon, his wonderful description of what might be performed by refracted vision was unaccompanied by an explanatory diagram. It should not be forgotten, however, that the mathematical demonstration may lag a century behind the discovery. The conclusion also involves acceptance of the view that no ancient magnifying glasses exist, because such segments of spheres of glass as have been found are probably merely ornaments.

Chapter iii. deals with the age of progress from Kepler to Hevelius, and that debatable question, which Borellus tried to answer, namely, Who was the true inventor of the telescope? forms the subject of the fourth chapter.

Optical history in general occupies the first half of the book. The second half is termed a "Description and Illustrated Catalogue," a designation which conveys little indication of the interest with which the material has been invested. The microscopes described are those possessed by the Society. They have been divided into two groups A and B, with accessories in a third group C. The year 1850, by which time a fairly rational type of instrument had been evolved, has been selected as the boundary between the first and second periods.

The authors are to be congratulated on the successful conclusion of their labours, and the thanks of all concerned with the history of optics and the microscope are due to the Royal Microscopical Society for the publication of this valuable work.

JAMES WEIR FRENCH.

Modern Investigations in Materials.

Applied Elasticity. By S. Timoshenko and J. M. Lessells. Pp. xxi + 544. (London: Constable and Co., Ltd., n.d.) 25*s.* net.

THE importance of the strength and elasticity of the materials employed in engineering construction is well reflected in the frequency with which treatises on the subject appear. Prescott's book, with the same title as the volume at present under notice, was a specially notable contribution made a few years ago; but rather more abstract and mathematical than is perhaps desired by the majority of engineers. The volume here considered does not refrain from mathematical discussion, nor does it make any strenuous endeavour to simplify such methods, but it deals throughout with problems of definite practical moment, and its matter is in all respects up-to-date.

Mr. Timoshenko—well known for his original studies in elasticity—is responsible for the analytical Part I. of the volume, in which he incorporates much of his own original work. His chapter headings are of a very ordinary type, but a closer examination reveals that within each of these chapters there are many special developments quite unusual in treatises of this class. Chapter vi., on the bending of bars on elastic foundations, is, in its applications, a notable example of the author's powers; as are also Chapter viii. in which multi-throw crankshafts are treated, and Chapter ix. on curved bars. Chapter xi., on stresses produced by dynamical causes, is ambitious in its scope but, probably hampered by space considerations, it fails to do full justice to the modern technical problems of vibration.

Part II., on the experimental side of the subject, is by Mr. Lessells, who has conducted many researches on materials. His treatment is wide in range, and well defined in sectional detail. The important modern lines of fatigue, impact, and hardness testing are very clearly reviewed and presented; although the section on the effects of high temperature might have been extended with advantage. The separate chapter on theory of strengths is a welcome innovation in works of this kind.

The book is, in its general scheme, of an advanced order, mainly suited to senior students of the subject and to engineers who have to deal with the difficult details of modern design, but its wealth of treatment, summary, and reference on the outstanding modern problems and investigations of this important subject, give it a very high place in the rather lengthy list of works on the same subject.

Our Bookshelf.

Die neueren Milchindustrien. Von Dr. L. Eberlein. (Technische Fortschrittsberichte: Fortschritte der chem. Technologie in Einzeldarstellungen, herausgegeben von Prof. Dr. B. Rassow, Band 14.) Pp. xi + 119. (Dresden und Leipzig: Theodor Steinkopff, 1927.) 5 gold marks.

THIS volume deals with the industrial aspect of milk production. After a brief account of the composition of milk and a description of the chief chemical and bacteriological methods which are used in its examination, the production and supply of clean milk are considered. Attention is directed to the milking machine, the cleaning of the vessels in which milk is transported, and the bacterial content of milk. The supply of milk to towns is an important chapter, and whilst it is agreed that fresh raw milk is the ideal food for children and adults, provided it can be obtained of low bacterial content and free from dirt, it is held to be impossible, on account of the cost, in present circumstances to provide such milk for the main body of the population. Pasteurisation and the three main systems are described, and two methods, other than by heat, for the removal of bacteria are described.

The preparation of condensed milk and the apparatus used for the purpose are described, and the succeeding chapter deals with dried milk and its preparation. The use of dried milk for infant feeding is mentioned.

In view of the difficulty which is often experienced in disposing of surplus milk at the 'flush'

time of the year, the manufacture of casein has been found in some countries, *e.g.* the United States, New Zealand, Argentine, and France, to be of greater profit than was at first expected; separated milk is used, the fat being employed for butter-making. The uses of casein are manifold, and it now finds application in a number of trades.

Another milk by-product which often proves a great embarrassment to the cheese-maker is whey, the milk sugar of which is valuable. The commercial manufacture of milk sugar is given, together with details of the necessary plant.

The information and the technical details given in this volume are likely to be very valuable to those engaged in the milk industry, especially to the manager of a factory where the condensing or drying of milk is practised.

Handbuch der allgemeinen Chemie. Herausgegeben von Prof. Paul Walden und Prof. Carl Drucker. Band 5: *Mechanische Eigenschaften flüssiger Stoffe; Volumen, Dichte, Kompressibilität, Oberflächenspannung, Innere Reibung.* Von Prof. R. Kremann. Pp. xii + 598. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 46·50 gold marks.

A NOTEWORTHY development in physical chemistry during the last twenty years is the increasing amount of attention paid to those properties of liquids which are primarily due to the cohesive forces between molecules. Compressibility, surface properties, and viscosity have attracted the interest of many investigators, both in Europe and in America, and the new knowledge gained of the behaviour of liquids has found many important applications in industry. Prof. Kremann's book on the mechanical properties of liquids is therefore a welcome contribution to physico-chemical literature and provides a valuable work of reference for students and investigators in this field.

The book is divided into three parts dealing with volume relations, viscosity, and surface tension (including interfacial tension). Each section opens with a useful survey of the experimental methods available for measuring the property studied, followed by a discussion of the influence of temperature and pressure. The effect of chemical composition is next considered, and here one must pay tribute to the skilful manner in which the author has collected and correlated a large number of empirical relations, laying due stress upon those of greatest generality and theoretical significance. Finally comes an account of the behaviour of binary mixtures and solutions.

The book is written avowedly from the experimental viewpoint, so that a critical discussion of the molecular theory of liquids could scarcely be expected. At the same time, it seems unfortunate that such a discussion was not attempted, even if it only served to emphasise our ignorance of the laws of force between molecules. This, however, would involve a consideration of vapour pressure and latent heat with which Prof. Kremann deals only incidentally, although they, too, may be classed as mechanical properties of liquids. S. S.

Grass Land: its Management and Improvement. By Prof. R. G. Stapledon and Dr. J. A. Hanley. Pp. 159. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 5*s.* net.

DURING recent years increasing attention has been paid to the improvement of grassland from various aspects, including methods of cultivation, manuring, and the types of grass used for sowing down. Progress has been rapid, and is still continuing, and in this volume Messrs. Stapledon and Hanley have sought to epitomise the present position, though at the same time they fully acknowledge that many of the recommendations put forward are tentative in nature and may need modifying in the light of future experimental results. Their aim is to provide the most precise information possible to enable an intelligent farmer to apply new methods in his management of grassland, wherever such improvement offers prospects of increased revenue. It is pointed out that one of the chief difficulties in estimating the financial value of improvements to date is the lack of adequate information in the form of farmers' costings accounts.

Grassland may be divided broadly into two types, natural and semi-natural, embracing respectively the large un-enclosed areas of moorland, heath, downs and saltings, and fenced-in land associated with the homesteads. The latter naturally offers the greatest opportunities for improvement, the appropriate methods of treatment varying widely according to local conditions.

In many cases manurial applications, to be effective, must be preceded by adequate mechanical treatment, or by the amelioration of soil acidity by the judicious use of lime, notably in very smoky districts. The necessary difference in grazing and meadow treatment is indicated, and information is given with regard to the various methods of renovating grassland and to the production of permanent and temporary leys. A bibliography of selected literature concludes a most useful summary of grassland treatment.

Principles of Soil Microbiology. By Prof. Selman A. Waksman. Pp. xxviii + 897 + 19 plates. (London: Baillière, Tindall and Cox, 1927.) 45*s.* net.

THE demonstration of Schloesing and Muntz in 1877 that in sewage beds ammonia is converted into nitrate by biological agencies, and the further demonstration by Warington that two species of bacteria are involved, followed by their isolation by Winogradsky, turned the thoughts of soil investigators towards the biological aspect of soil fertility.

Naturally, the earlier work was confined to the bacterial population of the soil, and, in text-books published round about 1910, nitrification, nitrogen fixation, and denitrification were the main topics of discussion. Since that date, the subject has gradually assumed a broader aspect, and it has been realised that not only bacteria, but also protozoa, algæ, and fungi are playing a part in the various soil reactions.

In the voluminous treatise prepared by Waks-

man, soil microbiology is treated under three main divisions, the first two dealing with the occurrence, isolation, identification, and cultivation of soil organisms, and the third where their chemical activities are discussed. Throughout, the treatment is very complete, and in this perhaps lies one of the faults of the book; for without a wide knowledge of the subject there is a danger of not seeing the wood for the trees. Also, the author would have been well advised to show more critical judgment in discussing the work of others: as the book stands, students will have difficulty in differentiating the really good pieces of research from the mediocre or even bad. Apart, however, from these blemishes, Waksman has done good service to soil microbiology in producing so compendious a volume, the citation of more than 2500 references being a service in itself. His book is essential to all those interested in the micro-organisms of the soil.

Money and Monetary Policy in Early Times. By A. R. Burns. (The History of Civilisation Series.) Pp. xiii + 517 + 16 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1927.) 25*s*. net.

IN a conclusion which sums up the lines of argument of his valuable study of money as an element in the growth of early civilisation, Mr. Burns enumerates the deficiencies in the evidence, for, as he says, it is as well to keep in mind the things we do not know, as well as those we do. This is wise, for the gaps in our evidence are great and the theories of numismatists and archæologists have not always been marked by restraint. For example, throughout the whole period with which the author deals, there is no evidence of the legal weight of coins, nor is it known what were the practical conditions of monetary law and the circulation of currency. How did the State decide what was the quantity of coins to be circulated? This is a point of peculiar importance for Mr. Burns's study, of which the originality lies particularly in his investigation of the use of monetary issues in relation to political supremacy. As a result he shows how, broadly, a distinction can be drawn between the policy of the great eastern empires and that of the Greek States.

In regard to the early stages of a currency, Mr. Burns shows himself sceptical as to the existence of a primitive state of exchange which is unorganised barter. This he regards as only a logical postulate for purposes of exposition. Nor does he think that the ox, though the first unit of value, recognised over a wide area, was ever in general use as a means of exchange. The author is to be congratulated on a sound piece of work which cannot fail to stimulate further research.

The Working of Aluminium. By Edgar T. Painton. Pp. ix + 214 + 20 plates. (London: Chapman and Hall, Ltd., 1927.) 13*s*. 6*d*. net.

THE scope of this book is not exactly indicated by its title, as the making of alloys and of castings is included as well as the mechanical working, heat treatment, welding, finishing, and testing of aluminium and the light alloys. On all these matters the author is informative, and his account of them shows practical familiarity with the workshop. Aluminium presents difficulties in machining and finishing to those who are accustomed to other metals, and many useful hints may be gathered from the instructions here given, and from the descriptions of actual operations, mainly in connexion with the motor industry. Theoretical discussions are deliberately excluded, and there are no photomicrographs, but the brief notes on age-hardening and on the 'modification' of the alloys of aluminium and silicon are accurate so far as they go.

In the account of heat treatment and melting, some mention might have been made of electric furnaces, which are now so widely used for these purposes in America, but are also used in Great Britain, and in the chapter on testing reference might have been made to the use of diamond pyramid indentation instruments, which are already displacing the scleroscope in some laboratories, on account of their greater accuracy when used with thin sheets. Among processes for the protection of aluminium surfaces, the excellent method of anodic oxidation, is described, with its further development, the application of dyes to the oxidised surface. Electroplating with cadmium is mentioned, but not the now extensively used process of plating with zinc. The illustrations are numerous and good, but the publishers have used an excessively loaded paper, which makes the book inconveniently heavy and throws an undue strain on the binding.

Ergebnisse der Biologie. Herausgegeben von K. v. Frisch, R. Goldschmidt, W. Ruhland und H. Winterstein. Zweiter Band. Pp. vi + 729. (Berlin: Julius Springer, 1927.) 56 gold marks.

THE price of this, a volume of essays by specialists, is too much. £2 : 16*s*. for a book, which from an English publisher would cost £1, or at most £1 : 10*s*., is not justifiable. Recently two correspondents in NATURE directed attention to the cost of other Julius Springer publications, and we cannot advise the reader to purchase this volume at the price asked for it by the publisher.

The volume contains three essays on tropisms in plants—by P. Stark, L. Brauner, and W. Zimmermann. So far as the reviewer is able to judge, these sections are comprehensive, and they all have extensive bibliographies. There is then a chapter on urea, which the reviewer has been informed is good. This is written by A. Kiesel, of Moscow. In the section following, F. von Wettstein discusses heteroploidy at length. The Golgi apparatus is the subject of another chapter by W. Jacobs. This part is quite good and comprehensive.

Following this is a biochemical chapter on striated muscle fibre, by Bierdermann. This will be found useful to physiologists interested in muscle contraction, etc. An article on the spleen, by E. v. Skramlik, is followed by a section by Richard Goldschmidt on intersexuality, etc. This, as one might expect, is a valuable and interesting review of the subject.

J. BRONTË GATENBY.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Progressive Lightning.

IN NATURE of Nov. 20, 1926, p. 749, I showed how, by the use of a pair of photographic lenses carried on a rapidly revolving disc, information should be obtained as to the time any part of a flash of lightning lasts, how long it takes to get from any one part to any other part, where it begins and where it finishes, and how, if at all, succeeding flashes in a multiple flash differ in these respects from the pioneer flash which, so to speak, blazes the trail and has more to do to find a way which the others have merely to follow.

I had made this apparatus and carried it about for twenty-six years without obtaining a photograph when I wrote the article above mentioned. Since that time Dr. G. C. Simpson has kindly taken charge of it, but he had not so far been more successful than I in obtaining a suitable flash. At the end of June last he let me have the machine again to bring to this laboratory, where, as the guest of Mr. Alfred Loomis, I am exceptionally well placed for observations of this kind. The laboratory is at the top of a granite hill at an elevation of about 900 feet, and similar dome-shaped hills thickly clad with forest extend in all directions as far as the eye can see.

FIG. 1.

In the last month there have been two unusually severe heat spells accompanied by innumerable thunderstorms, but not until midnight, Aug. 5, did I see any clean flashes following one another in approximately the same direction. By clean I mean not obscured by intervening rain. I was fortunate to get one of these on to the plate with the lenses revolving in 4-inch circles at a speed of about 12 turns per second. For a preliminary picture I felt it safer to employ a low speed. This may be taken to be about 12 feet per second or 3600 mm./sec. The focal length of the lenses is 6 inches or 150 mm. The length of the image of the flash is 22 mm. which would make the length of the flash, or at least the visible portion of it, about $\frac{1}{7}$ of its distance. I judged this to be about 10 miles or 16 kilometres.

It so happened that the two images of the flash made by the two lenses were in line with one another, so that any aberration due to the motion of the lenses would displace the later portions of the flash sideways and in opposite directions. In order to obtain a measure of this displacement I scribed a straight line on the negative right through the two images. Measurement against this line would then show distortion with certainty and considerable accuracy. Stereoscopic examination, however, is more convenient, especially if the flash did not begin at one end and leave off at the other.

For this purpose a print is cut in two, and the two images are mounted side by side with the scribed lines parallel and square to the line joining the eyes. The two prints were so placed on the card that the two images were being carried towards one another all the time that the flash lasted. This is made evident by the sharp edges of the two images being remote from another while they showed the fading away of the light on the sides nearest to one another. If, then, any part of the flash had been later in time than any other, the images of this part would be nearer together, so that, seen in a stereoscope with the scribed line apparently upright, this part would appear nearer than other parts.

Actually, on looking at the mounted pair of images reproduced herewith (Fig. 1), the middle nearly vertical part with a small kink in it appears nearest, while the part bent to the left below seems to come from behind. Similarly, the sharp bend to the left above also seems to come from behind, but not so far behind, and the nearly vertical part from this up into the cloud appears again nearly vertical. The interpretation of these appearances then is as follows. The flash started at the ground, and almost immediately after started also in the length next the cloud. The flash then travelled from both these parts and finished in the middle upright portion about 1/7000 second later.

This was a single weak little flash with no overflow for succeeding flashes, so that it is not surprising that any part of it lasted no more than about 1/3600 second, the image being about 1 mm. wide before the very rapid fading away of the light. If it should be thought that the width of the image is due to mere imperfection of focus, the answer is that 4 mm. from the lower end and to the right there is a small branch flash on each image which is so sharp and thin as to be barely visible on the print. In each image this emanates from the leading edge. In the stereoscope this appears to come from behind, so it may have been the trigger of the whole discharge.

It may perhaps be well to state that the stereoscopic effects described above can have no relation to any stereoscopic effect which the two lenses as stationary lenses could have produced, because one of these effects is at right angles to the other. Besides, in a distance of several miles, a four-inch separation of the lenses would be inadequate. If they were separated 20 or perhaps 100 metres, then a very striking real stereoscopic view would be obtained.

It will be evident that as the linear displacement in the images due to time lag in the lightning depends only on the lag and on the linear speed of the lenses, the distortion of shape will be greater as the images are smaller, so that distance in the lightning, for example, not nearer than three miles, and short focus lenses, will make the stereoscopic effect more conspicuous. With much increase of size of the lens disc, the photographic plate might become inconveniently bulky and expensive. In such cases the obvious equivalent of two fixed lenses one above the

other, and with films travelling horizontally in opposite directions, might be preferred. Kinematograph lenses and films would then be suitable.

While I attach no importance to the rough numerical results obtained from this first experiment, I do maintain that it indicates that the method of oppositely moving images is capable of giving useful and certain information, and that a meteorological observatory might well be equipped with a special camera designed for higher speeds than my modest pioneer apparatus. Information as to fact can do no harm.

C. V. BOYS.

The Loomis Laboratory,
Tuxedo Park,
New York, Aug. 11.

On Co-ordinated Biological Research.

IF researches dealing with the relation of organisms to the environment are to approach in precision and completeness those dealing with matter and its physical attributes, it is essential that problems like that outlined below should be attacked by a team of workers, working simultaneously and in co-operation. Biological work of this kind may be accurate, valuable, and interesting, and yet fail in completeness for lack of contemporary data, as a review of recent work would readily show.

During recent years I have studied the general biology of oyster populations (*O. edulis*) in mass and in individuals in relation to general environmental conditions throughout successive seasons in different localities. From these studies it is clear that populations vary in their biological manifestations directly with the environment; for example, the incidence of general shell-growth, spawning, sex-change, and fattening can be predicted approximately from a knowledge of the environmental conditions, of which temperature range and rate of temperature change are the most important; the incidences vary in different localities.

It has also been demonstrated that *O. edulis* changes from femaleness to maleness automatically at, or a few hours after, the instant of egg-spawning (*Jour. M.B.A.*, **14**, p. 967; 1927), and it is clear from the studies mentioned above that the main change in the population from maleness or neuter to obvious femaleness occurs just before and during the breeding season: further, the amount of change in the population to femaleness at the beginning of the breeding season depends upon the nature of the environment. There are indeed good presumptive grounds for concluding that certain oysters, which are—or have recently been—male, will begin to produce eggs—whether they still retain sperm or not—provided (*a*) that the food-reserves have attained a certain concentration, (*b*) that the temperature of the medium is above a certain level: hence the occurrence of hermaphrodites. These conditions are not inconsistent with the possibility that certain substances may have hormonic value.

The problem to be solved is, therefore, How much of the sex-change is due to internal or to external factors acting separately? or alternatively, What combination of internal and external factors will maintain maleness or cause the assumption of femaleness? I have stated elsewhere that anything can be a male, but that some more than ordinary attribute is required to make a female. Broadly applied, this statement is true of the oyster, and the obvious preliminary requirement for a functioning female is abundance of food-reserves. Therefore, to obtain *conclusive* evidence of the factors controlling sex in *O. edulis*, it will be necessary in the first place to obtain seasonal chemical analyses of individuals the recent sexual history of which, as well as actual sexual condition at the instant of examination, is known. It can perhaps be predicted that the total rate of metabolism in debutante females will be higher than in the declining and perhaps fully ripe males, but for the clear establishment of the cause of sex it will be necessary to obtain accurate information on this matter correlated with conditions as regards food-reserves. When the results of these researches are known, it is possible that a basis may exist for critical experimental work.

To understand variations in the rate of metabolism and correlate the results in a direct manner with the environment, it will be necessary to know the seasonal variations in the plankton over the natural oyster beds. The seasonal variations in plankton are undoubtedly controlled in part by the supply of limiting food-factors, *e.g.* phosphates, nitrates, and in part by the biological characters of the constituents; it is therefore necessary to know the variations in the limiting food-factors in the area of investigations.

It has been shown that the growth of shell-material occurs at about the periods of the year when the storing of food-reserves especially occurs (*J.M.B.A.*, **15**; (1928), so that the interrelationship of these two processes is also bound up with sex. Shell-growth, however, is a problem which itself demands—besides biological information regarding internal condition—full knowledge also of the physical conditions prevailing over the beds, *e.g.* variations in salinity, temperature, alkalinity, and even general illumination. The experimental analysis of the factors concerned in producing that kind of shell-growth which may occur when oysters are disturbed during the non-growing season (loc. cit., 1928) would be most satisfactorily performed when known natural conditions on the beds can be used as a control. The possibility of predicting the beginning of shell-growth to within a period of one or two weeks (loc. cit., 1928) also offers an excellent opportunity for the study of calcium metabolism, and significant determinations of the seasonal variations in the metallic constituents of the blood.

It is obvious that one person alone cannot investigate all these matters as they should be investigated, that is, simultaneously. For this reason I came to the conclusion, and reported last year, "that a definite scheme of co-ordinated research might now be formulated to attack simultaneously in the future the factors underlying shell-growth, sex and sex-change, spawning and fattening in the oyster, and the more exact relation of these to the environmental—and experimentally controlled—conditions."

A scheme of this kind, it is true, need not be confined to the oyster, but might also be applied to the herring, the plaice, the haddock, the salmon, or other organisms, but it is doubtful if the results from any of these piscine biological subjects would be as valuable from the point of view of fundamental biology as those which might be obtained from a sedentary sex-changing organism like *O. edulis*. There are other species of oyster similar in biological characters to *O. edulis*, and a scheme like that outlined above might be carried to fruition in almost any country, but everywhere great difficulties will have to be overcome. In England there would seem to be little chance of the adoption of such a programme of co-ordinated research, unless there were universal approval and the various bodies interested in fundamental research combined to provide the costs and the personnel.

J. H. ORTON.

Marine Biological Laboratory,
The Hoe, Plymouth,
Aug. 7.

Displacement of Liquids in Capillaries.

THE phenomenon to which this communication refers is so striking, and its probability of occurrence in any chemical laboratory so great, that the absence of mention of it in the literature was very surprising to me.

If one places in a glass tubing, 5 mm. in diameter or less, drops of two immiscible liquids, end to end, so as to form a liquid-liquid interface, the continuous bubble these two liquids make will begin to move in the direction of the liquid of greater surface tension, and continue so indefinitely depending on the length of the tube. By raising the end of the tube toward which the bubble is moving to a certain height from the horizontal, the motion of the bubble is stopped ; when it is raised still higher it slides back, and when lowered below the stationary height it

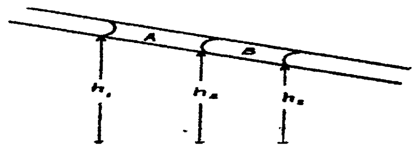

FIG. 1.

will move up again. It is evident from Fig. 1 that at equilibrium

$$(1) \qquad P=[(h_1-h_2)\rho_A+(h_2-h_3)\rho_B]g$$

where P is the pressure, ρ_A and ρ_B the densities of the liquids, and g the acceleration constant. The force $\pi r^2 P$ exerting this pressure is the resultant of the forces acting at the three interfaces, and therefore

$$(2) \qquad \pi r^2 P = -2\pi r\sigma_A \cos\theta_A + 2\pi r\sigma_{AB}\cos\theta_{AB} + 2\pi r\sigma_B\cos\theta_B$$

where r is the radius of the capillary, σ is the surface tension, and θ the angle of contact.

The resultant pressures become quite measurable when we make use of small capillaries, as is shown in equation (2), written in the form

$$(3) \qquad P=\frac{2}{r}\Big(-\sigma_A\cos\theta_A+\sigma_{AB}\cos\theta_{AB}+\sigma_B\cos\theta_B\Big).$$

By modifying the conditions the liquid column can be made to move in the opposite direction ; that is, if we construct a capillary as illustrated in Fig. 2,

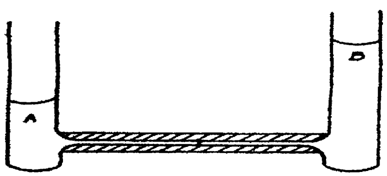

FIG. 2.

where the ends of the liquid column extend into the tubes of a cross-section where capillarity is not displayed, the liquid-liquid interface will move in the direction of the liquid of smaller surface tension.

The pressure developed under this condition is given by

$$(4) \qquad 2\sigma_{AB}\cos\theta_{AB}$$

Bartell and Osterhof,[1] in their work on 'wettability' of solids, measured such pressures in compressed powders, and arrive at the same relationship as in equation (4), but in a complicated manner.

This manifestation of surface phenomena is being utilised in my laboratory in measuring interfacial tensions, angles of contact, and adhesion tension of various liquids against glass.

J. L. SHERESHEFSKY.

Gulf Oil Companies' Fellowship,
Mellon Institute of Industrial Research,
Pittsburgh, Pa., July 9.

[1] "Colloid Symposium Monograph," vol. 4, p. 240; 1926.

Wave-length Shifts in Scattered Light.

RAMAN and Krishnan have recently described a new type of radiation emitted by organic liquids when illuminated with the light of a mercury arc, or with selected lines from such an arc. Lines are found in the spectrum of the scattered light at wave-lengths which are not present in the illuminating source. In the case of benzene the wave numbers of the shifted lines differ from those of the incident lines by amounts which are equal to the wave numbers of certain infra-red absorption maxima of the molecule. Raman and Krishnan state that these lines represent the scattered light of modified wave-length predicted by Kramers and Heisenberg in their correspondence principle treatment of dispersion. I believe this interpretation is correct. However, the evidence that these lines do not constitute a fluorescent emission, following the absorption process after a finite interval, is qualitative. First, Raman states that the radiation scattered with modified frequency from a cloud of carbon dioxide brightens up in the same way as the ordinary scattered light when the cloud is formed. Further, the shifted radiation is polarised nearly as strongly as that which suffers no change of frequency.

These facts indicate that this radiation is coherent, which would presumably not be the case if it were due to absorption followed by emission after a finite time. Of course, the absorption coefficient of benzene is rather small in the region studied, but it may readily be large enough to account for the retention of an amount of energy sufficient to give rise to the very weak modified scattering. In the present state of our knowledge about the mechanism of general absorption in liquids, the possibility cannot be dismissed offhand.

The purpose of this communication is to direct attention to an alternative method of settling this interesting question, independent of assumptions about the coherence properties of the radiation. It consists in determining whether there is a time lag between the reception of the incident light and the emission of the scattered radiation of modified wave-length. Several methods for determining such lags have been described by R. W. Wood (*Proc. Roy. Soc.*, **99**, 362 ; 1921). In regard to time resolving power, the most efficient of these is the method of Abraham and Lemoine, involving the use of a Kerr cell as a very rapid electromagnetic shutter. Gottling (*Phys. Rev.*, **22**, 566 ; 1923) has used this method to show that the phosphorescence of barium cyanoplatinite does not commence until 2×10^{-7} seconds after the illumination has commenced. For rhodamine the interval is 2×10^{-8} seconds. It is appreciated that the principal difficulty in applying this method to modified scattering is the small intensity of the light. However, since the modified light can be observed with the aid of colour filters, it is very likely that such observations can be made successfully.

In 1925, Foote and Ruark discussed in *Science* (vol. 61, p. 263) the existence of the scattered wave-lengths of Kramers and Heisenberg in the spectra

n metallic vapours in the arc ... nated ... their own monochromatic ... conclusion was that such lines have not been observed in the spectra of the alkaline earths. An extension of this line of investigation, using very long exposures, is much to be desired.

In the spectra obtained by Raman and Krishnan with water and methyl alcohol, the modified radiation consists of broad bands. Such is not the case with benzene, toluene, pentane, and ethyl ether. It may be that the breadth of the band in the case of methyl alcohol and water is due to some specific property of the OH group, but I believe it more probable that the breadth is due to the associated character of these two liquids. It is natural to expect that the vibration frequencies of molecules would be altered by association.

ARTHUR EDWARD RUARK.

Gulf Oil Companies' Fellowship,
Mellon Institute of Industrial Research,
University of Pittsburgh,
Pennsylvania,
July 20.

The Nierenstein Reaction

... chloride, ... and Robinson (*Jour. Chem. Soc.*, p. 1316; ...) have modified the original method described by ...bons and Nierenstein (*Jour. Chem. Soc.*, **107**, 1491; ...) as follows:

...) They added the benzoyl chloride to the diazomethane instead of using the reverse procedure preferred by us.

...) They carried out the reaction at a temperature "maintained at -5° to 0°," whereas this is not ...d by us, since we work at laboratory temperature.

...) They attempted the separation of the ω-chloroacetophenone with light petroleum, and not by means of vacuum distillation as stated by us.

...e effect of (1) was emphasised in my previous ... (NATURE, June 16, p. 940), and furthermore, ...versing their method of mixing the reactants, ...ey and Robinson (NATURE, July 28, p. 130) ...ow able to record a yield of 9 per cent of ...roacetophenone instead of a trace, detectable ... the powerful lachrymatory properties and ...teristic odour of the compound." This yield ... much lower than that recorded by Clibbens ... Nierenstein, and since this can be attributed ...o difference in technique, points (2) and ...ve been investigated by me, in collaboration ...r. T. Malkin, with the result that it is found: ...that by working at a low temperature very ... chloroacetophenone is produced. ...that by fractional crystallisation from light ...um, which is a most unsatisfactory procedure, ...d is reduced to 50 per cent of pure ω-chloro...enone.

...w of these results I briefly repeat the general ...e of the reaction:—Diazomethane prepared ...f a gas according to Staudinger, or in ethereal ... according to Pechmann, is slowly passed or ... into an ethereal solution of the acyl chloride ...emperature; for example, in the experiment ...scussion, diazomethane from 17 c.c. nitroso...ethane is distilled with ether over a period of ...o a solution of 10 gm. benzoyl chloride, dis... 75 c.c. dry ether (Grignard), the temperature ... To the ethereal solution (350 c.c. in the ... experiment with benzoyl chloride) is added ...·5 c.c. glacial acetic acid, and the ether ... off, during which process any excess of ...ane and ω-diazoketone is destroyed. The ... up according to the details ...iven in each case (in the experiment with benzoyl ...hloride the residue is distilled *in vacuo*).

I hope that by keeping to these conditions Dr. ...radley and Prof. Robinson will now be able to cor...oborate our results. Failing this, Dr. Malkin or I ...ill be glad to demonstrate the reaction to them or any ...ther of their colleagues they should choose to send ...own to Bristol. The experiment with benzoyl chloride ...an be carried out in one afternoon.

M. NIERENSTEIN.

The University, Bristol.

...ociation Energy of Nitrogen.

THE so-called ammonia band at 3360-70 A., photographed first by Eder in 1892, has since been studied and measured by many authors. Fowler and Gregory (*Phil. Trans. Roy. Soc.*, **218**, 351; 1919) have published beautiful photographs of it. Lately this band has been attributed by Barrat (*Proc. Roy. Soc.*, A, **98**, 40; 1920), Hulthen and Nakamura (NATURE, **119**, 235; 1927), and others to the NH molecule. Using R. W. Wood's arrangement for the optical excitation of mercury vapour (*Phil. Mag.*, Oct. 1925, Sept. 1927), I have observed the appearance of it when about 4 mm. nitrogen and very little hydrogen—perhaps a few thousands of mm.—are admitted to the quartz tube containing the mercury vapour which is being excited by the light of a water-cooled, magnetically deflected mercury arc.

The NH band appears as a result of photosensitised fluorescence; then it disappears as soon as the line 2537 of the arc is absorbed or self-reversed. With the help of the wire-gauze method (see R. W. Wood, NATURE, **120**, 725; 1927) it has been determined that the intensity of the band in our case is proportional to the square of the intensity of the exciting light. The problem is to find an explanation for the appearance of the band with this intensity relation. Now, the little hydrogen present in the tube is probably completely dissociated by the excited mercury, so that we have practically a constant density of atomic hydrogen. The combination of nitrogen and hydrogen as a gas reaction will furnish sufficient energy for the emission of the band 3360-70. Its intensity will be then proportional to the product of the concentrations of atomic hydrogen and nitrogen, and since the first is practically constant, the concentration of atomic nitrogen must be proportional to the square of the intensity of the arc or, what amounts to the same thing, to the square of the number of excited mercury atoms. This relation can be interpreted if we assume that the atomic nitrogen is formed by three-body collisions of N_2 molecules with two excited mercury atoms:

$$N_2 + 2\,Hg' \longrightarrow 2\,N + 2\,Hg.$$

The only excited atoms which come into consideration are the 2^3P_1 atoms with 4·9 volts and the metastable atoms with 4·68 volts energy. The maximum of energy available in the best case for the dissociation of N_2 is then 9·8 volts; two metastable atoms would give only 9·36 volts, which is 1·5 to 2 volts less than the assumed value of 11·4 volts. We could have some more energy available if we suppose that the reaction $N_2 + 2\,Hg' \longrightarrow N + HgN + Hg$ takes place. The combination energy of HgN would then help to dissociate the N_2 molecule. An explosive black deposit of HgN should then be expected, but has never been observed in the tube in spite of running it uninterrupted for several days. This reaction seems, therefore, not to take place in our case.

It thus appears probable that the dissociation

energy of nitrogen is less than, or about, 9·8 volts, and not 11·4 volts as was calculated by Sponer and Birge. The matter will be discussed in more detail in another place in connexion with a study of the photosensitised fluorescence of several other molecules.

E. GAVIOLA.

Johns Hopkins University,
Baltimore, July 12.

The Instability of a Single Vortex-Row.

DR. HAROLD JEFFREYS, in his letter appearing in NATURE of Aug. 11, p. 206, mentions some interesting practical effects for which the principle to which it refers is responsible. To those which he mentioned may be added a physiological consequence for the circulation of the blood. As the blood-stream races past the cusps of the valves at the orifices of the heart, some of the eddies, to quote his words, "enter the dead water, where they produce a circulation with a reverse current" behind each valve. This disposition prevents extreme eversion of the valve, and facilitates closure of the valve without delay or hindrance so soon as the diastolic check of the stream current ensues, at end of the active beat. The anatomical channel is actually bayed out (sinus of Valsalva) in the case of the two largest blood-vessels, in order to favour development of what in the letter is termed the second row of vortices.

C. S. SHERRINGTON.

Oxford, Aug. 19.

X-Ray Studies on the Nitrides of Iron.

IN the preliminary report under the above title, published in NATURE of May 26, p. 826, the conclusion is drawn that the cubic γ-phase is a solid solution of nitrogen in γ-Fe. A further study of the photograms, however, makes a correction of this assumption necessary, for there are in the photograms two very weak lines which indicate that the nitrogen atoms have definite places in the lattice.

As was said in the preliminary report, the lines of the γ-phase are fixed, showing that the phase probably has a very limited homogeneity range. As to its limits, it was pointed out that the upper limit was probably between 5·7 and 6·1 per cent nitrogen.

The iron atoms certainly still form a face-centred cubic lattice ($a = 3{\cdot}789$ A.) and nothing in the photograms indicates that the elementary dimensions must be increased. If the nitride contains about 6 per cent nitrogen, it is most likely that there is one nitrogen atom per one unit cell, that is, per 4 iron atoms. The formula of the nitride then becomes Fe_4N with 5·9 per cent nitrogen.

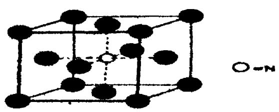

FIG. 1.

One possible position of the nitrogen atom is in the middle of the cell, as is shown in Fig. 1, that is, with the co-ordinates $\frac{1}{2}, \frac{1}{2}, \frac{1}{2}$. Another possible position has the co-ordinates $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$. The positions and intensities of all lines calculated on these assumptions in both cases agree very well with the observed ones.

To judge between the two structures is hard, as they give almost the same intensities of the lines. It must, however, be pointed out that the iron atoms of the first structure are not equivalent.

GUNNAR HÄGG.

Institute of Metallography,
Institute of General and Inorganic
Chemistry of the University,
Stockholm,
July 14.

The Crystal Structure of Solid Mercury.

As yet only two attempts[1] seem to have been made to determine the crystal structure of solid mercury with the aid of X-rays. The results of these investigations, however, were wholly contradictory.

I have tried to settle the question with the aid of a special spectrograph designed by Prof. Coster for crystal analysis at low or high temperatures. I have succeeded in obtaining with an exposure of one hour very good Debye-Scherrer diagrams by which the results of McKeehan and Cioffi, who found a simple rhombohedral structure, are fully confirmed. The main difficulty met with in my investigations was getting a preparation with sufficiently fine grain to be suitable for a Debye-Scherrer analysis. This was finally obtained by reducing mercuro-oxide by formic acid held in gelatine. The preparation contained very densely packed mercury globules of about 10 μ diameter.

These small globules showed the effect of undercooling in a very striking way. At the temperature of solid carbon dioxide ($-80°$), by far the greater part of them remained in the liquid state, as was clearly shown by the X-ray photograph obtained, in which the amorphous band of liquid mercury was predominant.[2] Only by hammering the preparation at a temperature below the freezing point of mercury was it possible to obtain mercury crystals in such abundance that very strong Debye-Scherrer lines were obtained. These conclusively support the views of McKeehan and Cioffi. As these authors worked at a temperature of $-115°$, no transition point seems to exist between $-115°$ and $-80°$.

A fuller account of method and results will be published elsewhere.

M. WOLF.

Natuurkundig Laboratorium
der Rijksuniversiteit,
Groningen, Holland.

Continued Self-Pollination in Cotton.

COTTON, though included among self-pollinated plants, is subject to crossing, and the extent of natural cross-pollination under favourable conditions is so great that it is regarded by some as obligatory for keeping up the health and vigour of cultivated races.

Kumpta cotton (*G. herbacium*) yielded in the year 1915 one pure strain, which has been continued since then by the use of selfed seed. The pure line has thus been subjected to continued selfing for twelve years. During the last season the strain was thoroughly examined in the following characters: 1, height of the plant; 2, total length of limbs; 3, sterility of the anthers; 4, shedding of flowers; 5, number of bolls per plant; 6, yield of seed cotton per plant; 7, ginning percentage; 8, staple length; and 9, seed weight.

The results clearly showed that there was no deterioration in any of the above characters. From this it appears that twelve years' selfing has no injurious effect in cotton.

Sometimes a variety yields more than its pure line which is selected for yield. The cause of this is to be found not in the deterioration of the selection due to selfing, but in the hybrid vigour of the F_1 plants appearing in the open pollinated seed of the variety.

G. L. KOTTUR
(Cotton Breeder).

Agricultural Station,
Dharwar, India.

[1] L. W. McKeehan and P. P. Cioffi, *Physical Review*, 19, 444; 1922. G. Aminoff and N. Alsén, *Geol. Fören. Förhandl.*, vol. 44, January 1922.
[2] J. A. Prins, *Physica*, 6, 315; 1926.

Some Recent Work on the Light of the Night Sky.[1]

By LORD RAYLEIGH, F.R.S.

IT is now well known that the light of the night sky has little in common with the day sky. When the sun is 18° below the horizon, and the moon also below the horizon, night conditions may be considered to be established. A clear sky is of course necessary for the study of the luminosity. Unlike the day sky, it is found to exhibit very little polarisation. The intensity is considerably below the threshold of colour vision, and subjective impressions about its colour, which is sometimes described by imaginative writers as blue, have no basis in reality.

The chromatic constitution of the light of the night sky can be investigated by experiments with coloured glasses. We may select a red and a blue glass, and look through them at the night sky. The blue one will almost certainly be the brighter, owing to the Purkinje effect. We may superpose neutral glasses on the blue one until the intensities are matched, and we shall then have a test by means of which the night sky can be compared qualitatively with other sources as regards the blueness or redness of the light. It is only necessary to reduce the intensity below the threshold of colour vision, and to note which glass gives the brighter field.

It is found in this way that the day sky is much bluer than the night sky, which is nearly of the general colour of a piece of white paper illuminated by a half watt lamp at normal incandescence. In this comparison, the brightness of the paper may be suitably reduced by placing the lamp a long way off.

SPECTRUM OF THE NIGHT SKY.

Spectroscopy of the night sky is a difficult problem, and the most that can be made out by visual methods is that the green auroral line is present on a background of apparently continuous spectrum. Some writers have recorded that they can always see the green line. I myself can only see it when the brightness as revealed by the photometric method presently to be described is above the average. Many experienced spectroscopists have been unable to see it at all. The main instrumental condition is to use a wide slit and a high dispersion. Lenses may advantageously be dispensed with.

Photographic methods are necessary for a more detailed study of the spectrum. In a single night's exposure it is scarcely possible to do more than photograph the green line, using a one prism spectrograph with spectrum ratio not less than $f/2$ and an orthochromatic plate. I have constructed small spectrographs with an aperture ratio $f/0{\cdot}9$, and with these it has been possible with an exposure of many nights to photograph the apparently continuous background of the spectrum, along with two emission lines or bands at wave-lengths very roughly estimated as 4210 A. and 4430 A. The broad absorption lines *G*, *H*, and *K* of the solar spectrum are seen in absorption. These are probably to be attributed to starlight, which is superposed on the light proper to the night sky. The relative amount of starlight has not been determined. I believe it is largest in the blue region of the spectrum, and relatively unimportant in the yellow and red regions.

An exposure of many nights on an Ilford panchromatic plate failed to show anything in the red region of the spectrum.

It is noteworthy that the negative bands of nitrogen, which are the most important feature in photographs of the auroral spectrum, are not present in the night sky.

PHOTOMETRIC METHODS OF OBSERVATION.

For some years past I have been making systematic photometric observations on the light of the night sky. As we have seen, the spectrum consists partly of the green auroral line, and partly of apparently continuous background. It is desirable to treat these separately. The light is, however, too feeble to allow of spectrophotometry in the ordinary sense. The method adopted in this work is to analyse the light with colour filters. Three filters were used, one designed to isolate the green auroral line as nearly as possible, and the others designed to transmit the region (*a*) on the red side, and (*b*) on the blue side of the line, excluding the line itself in each case. These are called the red, auroral, and blue filters.

The standard comparison light consists in each case of crystals of potassium-uranyl sulphate, which are self luminous, owing to the radioactivity of the contained uranium which stimulates the fluorescence of the salt. There is reason to believe that when in a sealed vessel the source may be regarded as independent of external conditions, and constant, at all events for very many years.

The type of photometer chiefly used consists of a Lummer cube, with the field divided into two vertical strips. The right hand (transparent) is backed by the uranium salt; the left-hand part, silvered, reflects the sky with a colour filter interposed. Choice from a series of neutral glasses allows the filtered sky light to be matched with the standard.

The densities ($\log_{10}$ opacity) of the set of neutral glasses had the values

0·1 0·2 0·3 . . . . 0·7, etc.

The scale used for recording and discussing the results is a magnitude scale, that is, one in which each step is a constant multiple of its predecessor. The zero reading is that which gives a match without one of the neutral glasses. For example, a reading of −3 means that the third neutral glass has to be used *over the sky*. A reading is recorded as −3 if the

[1] This paper was sent in for publication to Prof. S. Chapman, F.R.S., chairman of the Committee of the International Research Council on Solar and Terrestrial Relationships, and received by him (as he confirms to me) on Monday, June 18.

same glass has to be used *over the uranium source*. Intermediate interpolated values are entered; for example, 3·5. The zeros for the three separate regions of the spectrum, red, auroral, blue, are related in an arbitrary manner, though the factor involved in passing from one neutral glass to the next is, of course, the same for each, so far as the glasses deserve the same neutral. Within the practical limits of experimental error they do deserve it.

It is to be noticed that the comparisons are not at all prejudiced by a difference in colour between the two lights. At these low intensities the eye sees everything in monochrome, just as the photographic plate does at all intensities.

If the intensities are to be compared at different places and at the same time, it is necessary to duplicate the instruments and to adopt one as a master standard. The others can be compared with it by means of an 'artificial sky' consisting of a diffusing screen of which the brightness can be controlled and measured by varying the voltage across the terminals of a small electric lamp used to illuminate it. The details are here passed over. Each local observer takes the readings with his own instrument as described. They are reduced to the standard scale at headquarters by applying a subtractive correction, which gives the result which would be obtained under the same conditions on the master standard instrument, with the filters belonging to the latter. The scale numbers thus adopted are those of the neutral glasses, thus the intensity is multiplied by passing up one unit by the anti-logarithm of 0·1 or 1·259. Three steps on the scale are equivalent to a factor of $(1{\cdot}259)^3$, or to approximately a doubled intensity. This is a convenient rule to remember.

PHOTOMETRIC OBSERVERS AND RESULTS.

For observations in various parts of the world, I have been able to rely on the kindness of scientific friends who either undertook the work themselves or were able to find other capable observers who were so kind as to undertake it.

The stations and observers were as follow: Hawaii (United States Magnetic Observatory, Ewa, Oaku—Mr. H. E. McComb); Victoria, British Columbia (Dominion Observatory—Dr. J. S. Plaskett, Mr. Harper, Mr. H. H. Plaskett, Mr. Pearce); Mt. Wilson, California (Mr. Humason, as arranged for by Mr. H. D. Babcock); Pomona College, Claremont, California (Prof. Brackett); Pinehurst, N. California (Prof. J. C. McLennan); Kingston, Ontario (observations received through Prof. J. C. McLennan); Arequipa, Peru (Dr. J. S. Paraskevapoulos, as arranged by Prof. Harlow Shapley); Lerwick Observatory, Shetland Islands (Mr. A. W. Lee, arranged by Dr. G. C. Simpson); England (Terling, Essex, and near Hexham, Northumberland, during part of the autumn—Lord Rayleigh); Cape of Good Hope (Dr. H. Spencer Jones); Gilgil, Kenya Colony, E. Africa (Mrs. G. Cole);

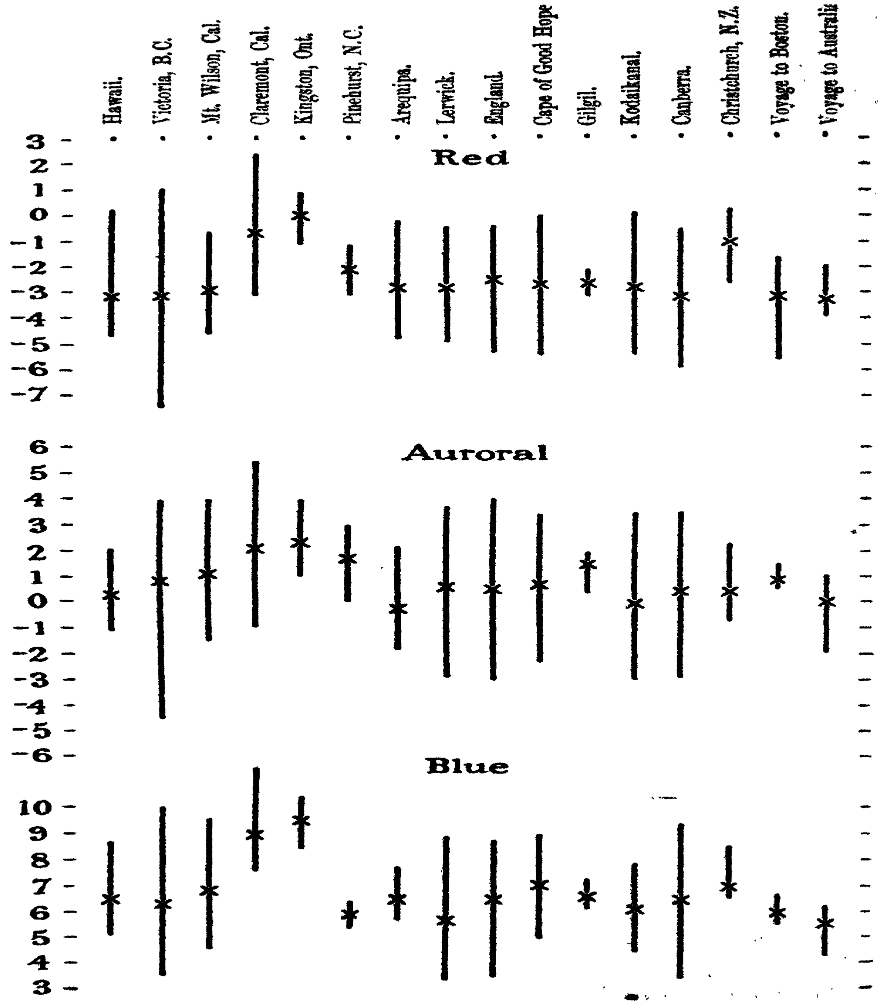

FIG. 1.

Kodaikanal Observatory, India (Dr. Royds, Mr. A. A. Narazana Ayer, Mr. P. R. Chidambara Ayer, Mr. S. S. Ramaswamy Ayyangar); Canberra, Australia (Commonwealth Solar Observatory—Dr. W. C. Duffield and Mr. A. L. Kennedy); Christ-

church, New Zealand (Mr. P. W. Glover); Voyage from Marseilles to Boston (Mr. H. D. Babcock); voyage from England to Melbourne (Miss Natalie Allen).

MEAN VALUES AND RANGE OF VARIATION.

The accompanying diagram (Fig. 1) gives the mean results in each component. It must be emphasised that though the red component, for example, is measured throughout on a consistent scale, this scale has an arbitrary difference (representing an arbitrary but constant intensity ratio to) from the scale used for either of the other components. The mean values are marked by crosses, and the extreme range in each component by the vertical lines.

The general conclusions to be drawn from this diagram appear to be as follows: First, fairly normal values can be stated for the intensity of each component at any part of the world. These values are somewhat as follows, on the various arbitrary scales:

Red	−2·5
Auroral . . .	+0·8
Blue	+6·5

The few cases which apparently lie outside these limits are believed to be due to observational causes. Full discussion is given in a paper presented to the Royal Society. The usual range of variation is from three to four fold in any given component. There is a strong correlation between the red and auroral intensities on any given occasions, and a rather less strong but still marked correlation between these and the blue. It is, however, definitely established that this correlation is not complete. A simple test for this is to match, for example, a red glass directly against a blue one by the addition of suitable neutral glasses, discarding the use of the self-luminous standard. It is found that this adjustment does not remain good for all succeeding nights, though it may be necessary to wait for some time before a marked change is observed.

ARE THE VARIATIONS AT DIFFERENT STATIONS CORRELATED?

The variations of intensity which form the subject of this investigation do not occur uniformly all over the world. They are conditioned, in large part at any rate, by local circumstances. To illustrate this, some striking illustrative cases will be given before discussing the subject by statistical methods.

Date.	Place.	Red.	Auroral.	Blue.
Jan. 16, 1926	England	−4·4	−1·4	+5·8
	Cape	−1·9	+2·0	+9·0
Mar. 2, 1926 .	England	−3·6	−0·2	+6·4
	Cape	−0·4	+2·0	+7·7
April 15, 1926	England	−3·6	−0·8	+6·4
	Cape	−2·4	+2·4	+8·3
Sept. 19, 1925	England (Northumberland)	−3·6	+1·7	+6·4
	Shetland (Lerwick)	−4·4	−2·8	+3·4
June 7, 1926 .	Hawaii	−4·7	−0·9	+5·1
	Canberra	−2·4	+2·1	+7·9

These cases have been chosen to show contrast. The mean values at the two places are in each case very nearly the same. Yet we see that occasion may be found where the intensity at one is double or more than double that at the other.

On calculating the correlation coefficients for approximately simultaneous observations at the pairs of stations mentioned, no significant coefficients were found. It will be seen immediately that there probably are long period variations which imply a correlation, but these are swamped by local irregular variations.

(To be continued.)

The Centenary of James B. Neilson's Invention of Hot-Blast in Iron Smelting.

By Prof. WILLIAM A. BONE, F.R.S.

IT may be considered singularly fortunate and appropriate that the forthcoming meeting of the British Association in Glasgow exactly coincides with the centenary of James Beaumont Neilson's epoch-making invention of the use of hot-blast in iron smelting, which was first conceived and demonstrated in that city. For it inaugurated a century of continuous advance in scientific fuel economy, and may be said to have done for iron-smelting what Richard Arkwright's inventions had previously done for cotton-spinning.

In 'praising famous men,' it is well to appreciate their personalities and upbringings as well as their achievements; and in many ways the case of James B. Neilson is of peculiar interest. He was born on June 22, 1792, in the village of Shettleston, near Glasgow, the son of Walter Neilson, a colliery engine-wright; his mother has been described as "a woman of capacity and an excellent housewife." After a village-school education up to the age of fourteen years, he first helped his father for a while, and afterwards became apprenticed to his elder brother John, an engineman at Oakbank, near Glasgow, who is said to have designed and constructed the first iron steamer that put to sea.

In the year 1814, Neilson took employment as a colliery engine-wright at Irvine, where a year later he married Barbara Montgomerie; in 1817 the failure of the colliery compelled them to move into Glasgow, where Neilson was appointed foreman (and five years later, manager and engineer) to the newly established gas-works, where he remained for the next thirty years.

This proved to be the turning-point in Neilson's life; for, besides ensuring him steady and congenial employment, his settlement in Glasgow brought educational opportunities of which he fully availed himself at the Andersonian College, where he studied physics and chemistry with conspicuous zeal and success. Not only did he thus improve

his own intellectual position, but afterwards he also succeeded in inducing his work-people—mostly illiterate Highlanders and Irishmen—to follow his example; and he established an institute, with lecture-room, library, laboratory and workshop for their instruction, thus becoming a pioneer in technical education. The results of his work and inspiration were soon seen in the improvements which were introduced into gas manufacture at the Glasgow works under his direction; for, among other things, he introduced the use of fire-clay instead of cast-iron retorts in carbonising coal, and of sulphate of iron in the purification of the gas thereby produced. Undoubtedly he was a most alert and progressive gas-manager and engineer.

Neilson's crowning achievement, however, for which his name will ever stand high in the list of scientific inventors, was in connexion with iron smelting, an industry with which, until about the year 1828, he had had little or no experience; and it affords a conspicuous example of how a scientifically minded outsider may sometimes see his way along simple lines to a new great advance in a manufacturing process which those in daily contact with it have entirely missed.

In certain experiments with coal-gas, Neilson had observed how its flame luminosity could be materially increased merely by supplying it with pre-heated air through a tube surrounding the burner. This simple experiment set him thinking, and was the starting-point of all that followed. He next found that the temperature of a smith's hearth could be raised by blowing it with hot instead of cold air. To-day this may seem so obvious as scarcely to be called a 'discovery'; but to the 'practical man' of a century ago it seemed new and even surprising, so little were the thermal aspects of combustion understood, outside of a few laboratories, such as at the Royal Institution in London, where ten years earlier Humphry Davy had discovered so many new things about flame.

When Neilson first propounded to the Scottish ironmasters of his day the idea that much fuel could be economised in the smelting furnace by the simple expedient of pre-heating the ingoing blast, they pooh-poohed it. It was (they said) common experience that the furnaces made a better quality and quantity of metal in winter than in summer, which result they ascribed to lower blast temperature. Neilson, on the other hand, thought it more probably due to increased moisture in the air in summer-time, thereby anticipating to some extent the ideas about 'dry blast' put forward and proved eighty years later by James Gayley in the United States. Fortunately for the world, he was not overborne by the wisdom of the ironmasters, but persisted in his own idea until its essential truth had been triumphantly demonstrated.

Neilson's basic English patent for the invention was filed on September 11, 1828, so that the forthcoming British Association meeting will exactly coincide with its centenary; the corresponding Scottish and Irish patents date from October 1, 1828. All were entitled "Improved Application of Air to produce Heat in Fires, Forges, and Furnaces, where Bellows or other Blowing Apparatus are required," and (after referring to the generation of the blast by these known methods), the material part of the specification ran as follows:

"The blast or current of air so produced is to be passed from the bellows or blowing apparatus into an air vessel or receptacle, made sufficiently strong to endure the blast, and through and from that vessel by means of a tube, pipe, or aperture, into the fire, forge, or furnace. . . . For an ordinary smith's fire or forge, an air-vessel or receptacle capable of containing 1200 inches will be of proper dimension, and for a cupola of the usual size for cast-iron foundries, an air-vessel capable of containing 10,000 cubic inches will be of proper size. For fires, forges, and furnaces upon a greater scale, such as blast furnaces for smelting iron, and large cast-iron founder's cupolas, air-vessels of proportionately increased dimensions and number are to be employed. . . . The air-vessel may generally be conveniently heated by a fire distinct from the fire effected by the blast or current of air. . . . The manner of applying the heat to the air-vessel is, however, immaterial to the effect if it be kept at a proper temperature," the latter being described as 'considerable,' and preferably, but not necessarily, that of 'red-heat or nearly so.'

From this it is evident that what Neilson claimed was, not some particular device or apparatus, but the principle of pre-heating air in combustion as a means of economising fuel, which until then had been unthought of. In regard to iron smelting, where its greatest success was to be, it should be realised that, a century ago, the invention meant that the expenditure of a small quantity of fuel (small coal) *outside* the furnace, for the purpose of pre-heating the ingoing blast, would save many times more fuel (coke) *inside* the furnace. To-day it means even more, because the blast is now pre-heated by the combustion of part of the furnace gases, which in those days were entirely wasted.

The first trials of the invention as applied to iron smelting, which were made at the Clyde Ironworks, near Glasgow, early in 1829, were immediately successful beyond the most sanguine anticipation. For, with blast pre-heated to 300° F. only, the total coal consumption fell from 8 tons $1\frac{1}{4}$ cwt. per ton of iron with 'cold blast' to 5 tons $3\frac{1}{4}$ cwt.; and in 1833, with blast pre-heated to 615° F., it was further reduced to 2 tons $5\frac{1}{4}$ cwt. only. Indeed, it was said that, as the outcome of these experiments, the same amount of fuel produced three times as much iron, and that a given volume of blast did twice as much work, as formerly with cold blast. Actually the average furnace output had increased from 36 tons 18 cwt. per week with cold blast in 1829 to 61 tons 1 cwt. per week with blast at 615° F. in 1833. Although, as now seems probable, some part of the great economy so achieved may have been due to the simultaneous adoption of less wasteful coking methods, as well as to some concurrent reduction in the boiler coal consumption per ton of iron consequential on the greater furnace

output resulting from the change from 'cold' to 'hot' blast, no less an authority than Sir Lowthian Bell, after an impartial survey of the facts of the case as known fifty years later, concluded that, leaving out of account the two factors referred to, the actual *direct* saving in fuel due to the introduction of hot blast by Neilson at the Clyde Ironworks between 1828 and 1833, must have amounted to *at least* 20 cwt. of coke (or say nearly 1¾ tons of coal) per ton of iron produced, a result achieved merely by imparting to the ingoing blast an amount of heat developed by the combustion of between 2 and 3 cwt. of small coal *outside* the furnace, which he characterised as being in itself "sufficiently astounding."

This was, however, by no means all; for in Scotland it was through Neilson's invention that the blackband ironstone discovered by David Mushet in 1802 first became available for iron smelting, having previously been useless for the purpose. Also, it enabled Scottish ironmasters to substitute raw coal for coke in their smelting operations. So great, indeed, were the combined advantages resulting from the invention that the Scottish output of pig-iron rose from 37,500 tons per annum in 1830 to 196,960 tons per annum in 1839, while the enhanced profits were admittedly £54,000 per annum. In South Wales the invention enabled the use for the first time of anthracite as blast-furnace fuel, the successful adoption of which in America in the year 1840 (entirely due, *as was acknowledged*, to "this simple discovery—the substitution of what is called the hot blast for the cold blast") undoubtedly founded the great Pennsylvanian iron industry, which to-day has attained to such enormous dimensions.

As time progressed, and the means of further increasing blast temperature improved, the advantages of hot blast continually increased for at least sixty years after it was first employed. Indeed, it may be said that the impetus of the pioneering work of Neilson went on until it was completed by the supplementary inventions of regenerative hot-blast stoves by E. H. Cowper and Thomas Whitwell during the years 1860–65, by which time it had revolutionised iron smelting and made possible the huge furnace outputs of the present day. It is interesting to know that Neilson was present and spoke at the meeting of Mechanical Engineers in London in 1860 when E. A. Cowper described his new regenerative stove for pre-heating the blast to 1300° F., which (as Neilson said) completed his own invention of 1828. When it is remembered that, with the exception of comparatively small amounts of 'cold-blast' iron which are still produced for special purposes, practically the whole of the world's present annual output of about 80 million tons of iron is produced in furnaces run with blast preheated to 1200° F. or higher, with coke consumptions ranging from about 18 to 30 cwt. per ton, according to the richness and porosity of the ore smelted, and with outputs running up to 1000 tons per furnace per diem, the enormous value of Neilson's invention to humanity can scarcely be exaggerated, and its centenary is an occasion for international celebration befitting its wide-world use and importance.

The question as to *why* the use of hot blast has effected such colossal fuel economies and furnace outputs in iron smelting during the past century has provoked much scientific research and controversy, and is perhaps even yet not fully understood, so much have we still to learn about the chemistry and thermodynamics of iron smelting. But it is scarcely too much to say that the far-reaching implications of Neilson's work were behind much of Lowthian Bell's classical investigation upon the chemical phenomena of iron smelting fifty years later, and still urge us on to further inquiries.

With the view of developing the business side of his invention, Neilson entered into partnership (in 1828) with Charles Macintosh (the inventor of 'water-proofing') and John Wilson: he needed strong support, because while the ironmasters of his day eagerly adopted his process, they did not always acknowledge his rights in it. It was said that some entered into agreements with him about it, but repudiated their obligations when the time came for paying. Be that as it may, however, in common with many other pioneers, Neilson seems to have been scurvily treated by most of those who profited largely by his inventions, and the story is a sad and unedifying one. For years he is said to have received nothing from them; indeed, an association of Scottish ironmasters was formed in 1840 for the express purpose of resisting any practical acknowledgment of the validity of Neilson's patent, thereby admitting its great technical success. Eventually, Neilson and his partners succeeded in establishing their rights after long and costly litigation against infringers, which became historic in the annals of patent law. So far as the English patent was concerned, they finally succeeded in the case of 'Neilson *v.* Hartford,' which was fought out in the Court of Exchequer in May and June 1841; but in Scotland, it was not until 1843 that the *cause célèbre* of 'Neilson *v.* Baird'—the trial of which in Edinburgh lasted nine days, and is said to have cost £40,000—finally vindicated the patent of 1828. During this action defendants admitted having made £260,000 profit by the use of hot blast, but denied the validity of the patent on grounds of verbal ambiguities; but it is satisfying to know that the Court ruled out this plea and finally decided the issue in Neilson's favour, although awarding him £11,876 only, instead of the £20,000 which he had claimed.

Neilson had joined the Institution of Civil Engineers in 1832, and in 1846 he was elected a fellow of the Royal Society. But he took fame very quietly, and in 1847 retired to a cottage which had been built in 1827 for Edmund Kean, the great tragedian, who there found it "glorious through the loop-holes of retreat to peep on such a world." In 1851 he moved to an estate which he had acquired in the Stewartry of Kirkcudbright, where he died on January 18, 1865.

The Glasgow Meeting of the British Association.

THE meeting of the British Association which opens in Glasgow next week will be the fifth to be held in that city. The first Glasgow meeting in 1840, presided over by the Marquis of Breadalbane, was attended by 1353 members, and resulted in grants being distributed for scientific purposes to the amount of £1546 16*s*. 4*d*. The general proceedings of that meeting were very similar to those of British Association meetings of later years; perhaps the most conspicuous difference being the opening of the meeting with an address not by its president but by Murchison on behalf of himself and his co-secretary, Sabine, in which the activities of the Association during the preceding year were reviewed. In addition to giving an interesting summary of such activities, the secretaries in their address stressed particularly the importance of the Association as a channel for impressing upon Government the opinions and claims of science, and it is of equal interest to note in the address indications of cordial co-operation in this respect between the British Association and the Royal Society. In 1840 the Association met in seven sections, A-G; section E, now devoted to geography, represented in those days medical science; D represented biology as a whole, and the younger sections H to M, representing various specialised subdivisions of biological science, are in the 1840 report conspicuous by their absence. Amongst the sectional officers of this first Glasgow meeting were: J. D. Forbes, Airy, Whewell, Graham, Lyell, Buckland, De la Beche, Smith, W. J. Hooker, Edward Forbes—assuredly an impressive list!

In 1855 the Association again met in Glasgow under the presidency of the Duke of Argyll, who in his opening address urged forcibly the claims of science to an important place in the school curriculum. Again there was a distinguished list of sectional officers—Section C standing out in particular with Sir Roderick Murchison as president, and Lyell, Darwin, Sedgwick, Hugh Miller, and Ramsay as vice-presidents.

The 1876 meeting, presided over by Thomas Andrews, was again one of much interest: the presidents of sections included William Thomson, W. H. Perkin, and Russel Wallace, while amongst other office-bearers were Clerk Maxwell, Stokes, Tait, Crookes, Haeckel, and Hooker. One of the two evening discourses, by Wyville Thomson, was devoted to the *Challenger* expedition, which had just returned from its great voyage of exploration.

The Glasgow meeting of 1901, under the presidency of Sir Arthur Rücker, still lingers in the memory of the older members of the Association as one of special interest and success. The members numbered 1912, and £945 was distributed in the form of scientific grants. Of the distinguished men who then presided over sections, Major MacMahon, Prof. J. Cossar Ewart, and Dr. H. R. Mill are expected to be present at this year's meeting. In addition to Sir Arthur Keith, who vacates the presidential chair in favour of Sir William Bragg, at least three other past presidents of the Association are expected to be present: Prof. Horace Lamb, Sir Oliver Lodge, and Sir Charles Parsons.

As will have been gathered from the summary in our last week's issue, the sectional programmes at Glasgow promise to be of great and varied interest. An outstanding feature of the meeting will be the numerous discussions upon problems of the day, some relating to pure science, others to its relations with industry, economics, or education: discussions in which many distinguished men of science will take part. Such discussions probably contribute more to the advancement of science than does the ordinary type of paper conveying to specialists the news of some original discovery in specialised research.

Important items of Association business which will come up for discussion by the General Committee at Glasgow will have to do with arrangements as to future meetings. Next year's is to be held in South Africa, and it is expected that a deputation will be present in Glasgow to discuss final arrangements. The place of the centenary meeting in 1930 will also have to be discussed, there being obvious practical difficulties in the way of holding that meeting in the city in which all would desire that it should be held, namely, York, where the Association held its first meeting in 1830.

In looking forward to a doubtless successful and interesting meeting at Glasgow, the thought suggests itself that the time approaches when the British Association may well prove itself to be an instrument of still greater national importance than in the past. Our civilisation has come to be entirely dependent upon science in many of its practical details: public health, food-supply, transport—of materials and ideas—industry, and the many other factors which make civilised existence what it is; but yet we find government and administration carried on practically entirely by men of literary training without any grounding in science. If our civilisation is to continue, there is need for such changes in our educational system as will ensure that not only our governors and administrators but also the mass of the people shall be given such a grounding. There are those who believe that the British Association is in an unequalled position for accelerating the advent of such educational reform, which has been long delayed but is becoming every year more urgent.

VISITORS FROM ABROAD.

An exceptionally large number of distinguished men of science from abroad will be present at the meeting. Notable among them will be the following:

Prof. M. J. Bonn, of the Commercial High School at Berlin, a well-known economist, especially on the economic history of Europe; Prof. Robert Broom,

of the American Museum of Natural History, New York. He was until lately professor of geology and zoology at Stellenbosch, South Africa, and keeper of fossil vertebrates in the South African Museum, Cape Town.

Prof. Dr. Viktor Christian, keeper of the Natural History Museum at Vienna: a distinguished authority on anthropology.

Dr. C. J. Davisson, of the Bell Telephone Laboratories, New York. He is notable for his work on thermionics and electron physics; Dr. George A. Dorsey, of New York, an authority on physical anthropology and ethnology, and curator of anthropology in the Field Museum of Natural History in New York.

Prof. A. von Eiselsberg, professor of physiology at the University of Vienna. He attends the meeting as representing Gesellschaft Deutscher Naturforscher und Aerzte, which is the German counterpart of the British Association.

Prof. Dr. W. J. de Haas, Natuurkundig Laboratorium, Rijks-Universiteit, Leyden, Holland, well known for his work on electric conductivity; Dr. Jul. Hartman, of Copenhagen, one of the leading younger Danish physicists; Prof. Olaf Holtedahl, Geolog.-Palæontol. Inst., at the University of Oslo, Norway, one of the leading authorities in Scandanavia on the palæontological side of geology.

Dr. John af Klercker, of Skanor, Sweden, a generous and public-spirited Swede of high scientific attainments, the foremost authority on the ethnology of Sweden; Prof. Douglas W. Johnson, of Columbia University, New York, a distinguished geographer, working mainly on the physiographical side, surface movements, relief, coastal changes, etc.; Dr. H. Spencer Jones, H.M. Astronomer, Royal Observatory, Cape Town.

Prof. A. E. Kennelly, professor of electrical engineering in Harvard University. He is attending the meeting as representing the American Association for the Advancement of Science.

Dr. A. Loir, conservator of the Museum of Natural History at Le Havre. He is attending the meeting as representing l'Association Française pour l'Avancement des Sciences; Prof. V. I. Lubimenko, of Leningrad.

Prof. C. E. McClung, professor of zoology at the University of Pennsylvania, Philadelphia, who is widely known for his work on chromosomes, and as the organiser of the service of *Biological Abstracts* designed to assist biologists in keeping abreast of new work; Dean S. Lailer Mathews, of the Divinity School, Chicago, one of the most eminent ecclesiastics in America with a European reputation; Prof. N. Maximow, of Leningrad, whose work on fungi and applied botany ranks high in scientific circles; Prof. Th. Mortensen, of the Zoological Museum, Copenhagen.

Prof. Y. Ogura, of Tokyo, distinguished by his work on fossil plants.

Prof. J. Reinke, emeritus professor of botany in the University of Kiel.

Prof. Johannes Schmidt, of the Carlsberg Museum, Copenhagen, whose researches on the life history of the eel are known to all biologists; Prof. O. Stern, of the Institut für physikalische Chemie, Hamburg, who has done important work in various branches of physical chemistry; Dr. F. L. Stevens, of the Department of Botany, University of Illinois, a distinguished economic botanist and an authority in plant pathology, diseases of food-plants, with special application to agriculture. He attends the meeting as representing the American Association for the Advancement of Science; Prof. F. E. Suess, of the Geological Institute, University of Vienna, famous for his work on tectonics, carrying on that of his father, the late Prof. Edouard Suess, whose work on "The Face of the Earth" is a standard classic.

Prof. Vuylsteke, of Brussels, who was formerly a professor at the University of Louvain. He became an honorary corresponding member of the British Association in 1886, having attended the meeting at Aberdeen in 1885.

Prof. P. Zeeman, of Amsterdam, whose work on magneto optics and related subjects is familiar to all students of physical science.

Obituary.

Dr. Charles Chree, F.R.S.

CHARLES CHREE was the second son of the Rev. Charles Chree, D.D., minister of Lintrathen in Forfarshire, a country parish a few miles from Kirriemuir—Barrie's 'Thrums.' He was educated at the Grammar School, Old Aberdeen, and at the University of Aberdeen, where he was awarded the gold medal as the most distinguished graduate in arts of his year. Like many other Aberdeen students, he decided to complete his studies at Cambridge, but his scholarship was so wide that he had difficulty in making up his mind whether to pursue the study of mathematics and physics or to become a classical scholar, as he had taken a high place in classics at Aberdeen. He once told the present writer that what finally decided him was the fact that his mathematical rivals seemed less formidable than the classical ones.

Chree gained a mathematical scholarship at King's College, Cambridge, and rapidly came to the front as a leading mathematical physicist. His degree of sixth wrangler in 1883, distinguished though it was, scarcely represented his ability. A serious illness originating in disease of the bone and necessitating amputation of a thumb prevented him from working for many months, and delayed his taking the Tripos as he had originally intended in the preceding year. He also took a first class in Part 2 of the Natural Sciences Tripos, taking geology as a subsidiary subject. His election to a fellowship at King's College followed in 1885, and in 1890 he was re-elected to a research fellowship.

During his stay at King's, Chree wrote many important papers, most of them on the somewhat abstruse subject of mathematical elasticity. The excellent work he did can be seen by looking up the many references to his name in Love's standard treatise on elasticity. He did good work at the Cavendish Laboratory, but at that time there were not many openings for research physicists, and the theory of elastic solids was not a subject which appealed to those who appointed university professors

In 1893, Chree was elected Superintendent of Kew Observatory, and until he retired from this post in 1925, he devoted himself to the study of terrestrial magnetism, atmospheric electricity, and allied subjects. Under his direction Kew attained the leading position amongst the magnetic observatories of the world. Until the National Physical Laboratory took over the work, Chree was responsible for the testing of thousands of chronometers, watches, clinical thermometers, and similar instruments.

During recent years Chree was president of the Section for Terrestrial Magnetism and Atmospheric Electricity of the International Commission for Geodesy and Geophysics. The immense amount of work involved in studying the vast records of observations made for more than a hundred years can only be appreciated by few. Yet Chree never spared himself in his unfaltering and unflinching search for truth. He always weighed evidence fairly, and never attempted to neglect those portions of it which failed to support the current theory. No one appreciated more than he did the vital importance of the researches now being made into the constitution of matter, and no one recognised more fully the futility of hoping ever to attain finality.

In his presidential address to the Physical Society in 1908, Chree mentioned the great practical utility of eminent men of science formulating theories on matters of general interest. For example, he mentioned Kelvin's theories of the internal heat of the earth and the age of the sun's heat. But he regarded these theories as scientific poetry, just as, in a somewhat similar way, Kelvin himself regarded Fourier's 'Theory of Heat' as a mathematical poem. It is the privilege of the young to dream dreams, and Lord Kelvin and many other scientists were always young.

In 1916, Chree gave the seventh Kelvin Lecture to the Institution of Electrical Engineers, taking as his subject "Terrestrial Magnetism"; atmospheric electricity had been discussed fully by Lodge in a preceding Kelvin lecture. Amongst other matters he discussed Maunder's recently enunciated 27-day period. He came to the conclusion that we are justified in saying that if a certain day is disturbed, then the days from 25 to 30 days later have more than the usual chance of being disturbed. The 27th day is that one on which the probability of disturbance is a maximum. A great deal has yet to be done in unravelling the exact nature of the relation between sunspots and magnetic phenomena; as he says in his monograph on "Terrestrial Magnetism" (1912): "We may perhaps at present be in the same position as medical science would be in if no distinction were recognised between small-pox, chicken-pox, and measles. In such circumstances the death-rate from eruptive diseases might well appear arbitrary. Astronomers presently may find it possible to recognise different types of sun-spots, and a magnetic relationship may then become conspicuous."

Chree was elected a fellow of the Royal Society in 1897. He received the degree of Sc.D. from Cambridge in 1895 and the Hon. LL.D. of Aberdeen in 1898. He was awarded the Hughes Medal of the Royal Society and a Watt Medal by the Institution of Civil Engineers. He was a past president of the Royal Meteorological Society and devoted a great amount of time to the various scientific societies to which he belonged. He was by far the most conscientious referee the present writer ever knew; no matter how long or how difficult the paper, he would referee it thoroughly.

To the staff at Kew Chree was *persona grata*; one of them, R. S. Whipple, who was with him for twelve years, was the son of Chree's predecessor, as was also his successor, F. J. W. Whipple. It would take many pages to make even a brief résumé of Chree's scientific work, which includes about a hundred and fifty valuable papers communicated to the *Philosophical Transactions* and *Proceedings of the Royal Society*, the *Philosophical Magazine*, the journals of many societies, etc.

In his domestic life Chree was happy, his sister presiding over his house in Richmond, and his brother, Dr. William Chree, K.C., a well-known member of the Scottish bar, accompanying them on holidays. At Cambridge Chree was a good tennis player, and he was fond of cycling and golf. He and his brother were trout fishers from their earliest days and had spent holidays fishing in Norway. When the last summons came early this year, Chree was in full bodily and mental vigour, and after finishing so far as possible the work on which he was engaged, he patiently and most bravely waited for the end, which came on Aug. 12. His work lives and will continue to live, and will make the path easier for coming generations.

A. R.

BARON ANATOLE VON HÜGEL.

BARON ANATOLE VON HÜGEL was born at Florence on Sept. 29, 1854; he was the second son of Charles, Baron von Hügel, his mother being the daughter of General Farquharson. His father was a distinguished soldier, diplomat, and man of science, who was awarded the Patron's Medal of the Royal Geographical Society in 1849 for his travels in Kashmir; he was also a horticulturalist of European fame. Thus inheritance, example, and environment shaped Anatole's future life.

In 1874 Anatole von Hügel was sent by his doctor on a voyage to Australia, and while in Australia, New Zealand, and other islands he collected natural history specimens, and in 1875 went to Fiji to collect birds. Against advice he penetrated into the interior of Viti Levu, and though the natives were in a state of great unrest, he made friends with them and became much interested in what they did and made, winning their confidence and affection by his sweet, simple disposition. Sir Arthur Gordon (later Lord Stanmore) had just been appointed the first Governor of Fiji, and Alfred Maudslay was also there at that time. All three

began enthusiastically to make ethnographical collections, which later were united to form the unrivalled collection now displayed in the Museum of Archæology and Ethnology at Cambridge. Von Hügel wrote voluminous notes on the natives, and he soon came to be an acknowledged authority on Fiji. For this reason he was appointed at the end of 1883 the curator of the newly established Museum of General and Local Archæology, which then consisted of the collections given to the University by the Cambridge Antiquarian Society. The collections were greatly increased in all departments of archæology, and particularly by local Saxon grave-finds, in the excavating of which the curator took an active part.

Under the fostering care and through the discriminating knowledge of von Hügel, the ethnographical collections became of such importance that the title of the museum was changed to that it now bears. The collections were greatly enriched by numerous valuable gifts from the curator, the Baroness, their family, and personal friends. For many years von Hügel worked unremittingly and single-handed for a pittance under most cramped and unhealthy conditions, which must have weakened a constitution that was never robust. It fell to him to undertake the arduous and repellent duty of collecting money for a new museum. He was himself repeatedly a generous donor, as were various members of his family. In time, sufficient money was raised to begin the new building, the details of which involved von Hügel in much work and worry. The foundation stone of the first block was laid by Eliza Margaret, Baroness Anatole von Hügel, on May 14, 1910. The weary work of raising new funds for the erection of the other blocks had to be renewed. The removal of the specimens from the old to the new building was an arduous and anxious task, as was their installation in their new quarters.

His sensitive temperament, conscientiousness, and continual ill-health made life very hard for von Hügel. In the autumn of 1920 he quite broke down, and in June 1921 he felt obliged to send in his resignation as from Dec. 31, 1921. As health permitted he continued to work in the Museum, and had the satisfaction of completing the installation of the Fijian collections. The end came after a long illness on Aug. 15 last.

The above-mentioned circumstances, combined with a difficulty in expressing himself in writing, and a natural diffidence, were the probable reasons why von Hügel has little published work to his credit, and helps to explain why his long-projected and much-looked-for monograph on Fiji has never been finished. After being appointed curator he was made an honorary M.A. of the University, and then he joined Trinity College. In May 1922 he was given the degree of Sc.D. *honoris causa* for his distinction as an ethnologist and for the great work he had done for the University.

No account of von Hügel can be complete without reference to the devotion of the Baroness, his happy home life, and his love for his garden. He and the Baroness were always unobtrusively doing kind actions. He was a sincerely religious man, and he exerted a profound influence on Roman Catholicism in Cambridge.

A. C. Haddon.

Prof. F. S. Carey.

The sudden death on July 26 of Prof. Frank Stanton Carey, who for thirty-seven years was professor of mathematics at Liverpool, first in University College and then in the University, removes one who did much valuable pioneer-work in the building up of a new university.

Born in Somersetshire in 1860, F. S. Carey received his early education at Bristol Grammar School, and then proceeded to Trinity College, Cambridge. He was third wrangler in 1882, placed in Div. 1 of Part II. of the Math. Tripos in the same year, and elected to a fellowship of Trinity in 1884.

In 1886, Carey was appointed to the chair of mathematics at Liverpool, which had been founded three years earlier, and already occupied by A. R. Forsyth and R. A. Herman. In this chair his life's work was carried out. A born teacher, he was exceptionally able to impart knowledge to the dullest of his pupils, and at the same time to inspire the most brilliant of them. Both types of men continuously sought his advice long after they had left the University, and they were always amply rewarded. He himself never ceased to be an enthusiastic student of pure mathematics, always keeping a youthful outlook and fully appreciating the modern ideas in that subject, vastly different as they are from all that he was taught at Cambridge.

Carey's original contributions to mathematics are not large: they consist of isolated papers on geometry, theory of numbers and groups. His text-books are better known, and have been used by a large number of students; they are "Solid Geometry," "Infinitesimal Calculus," and "The Elements of Mechanics" (of which he was joint author). His latest publication (also a joint one) was "Four-place Tables with Forced Decimals." But of his writings perhaps that which shows him at his best is his chapter on mathematics in the volume on "Modern France" published in 1922 by the Cambridge University Press. In this there occurs a sentence which reveals an admirable spirit for a university teacher: "Perhaps the new ways were invisible except to the eyes of youth." His culture was a wide one, and he appears to have been able to enter intimately into the spirit of the scientific pioneers of the seventeenth and eighteenth centuries.

In the administration of his University, Carey took a prominent part, and on council, senate, and faculties he always judiciously upheld the claims of science and scholarship. He rendered vital help in the establishment of the Tidal Institute. The library, Teachers' Training College, finance committee, and athletic club all benefited by his active sympathy and sound judgment. His death will be deeply regretted by a wide circle of friends and former pupils, many of the latter being teachers and engineers.

J. P.

News and Views.

THE choice by the British Association of Sir William Bragg as its president for the Glasgow meeting is a particularly happy one. His genial personality, simple yet charming style of exposition—an especially important qualification in view of the great tradition behind the inaugural address—and his connexion with one of the greatest advances of scientific knowledge in our time, fit him pre-eminently for the presidential chair. Those who had the privilege of hearing his first Friday evening discourse at the Royal Institution after his return from occupying (1886–1908) a chair at the University of Adelaide, and while Cavendish professor at the University of Leeds (1909–1915), when physicists were still struggling to understand the true nature of X-rays and inclining rather to a corpuscular than to the electromagnetic undulatory explanation, will remember how clearly the position was set forth (as afterwards in 1912 in his book "Studies in Radioactivity"), and how the advent of some great impending discovery was foreshadowed which would clear up the mystery. It was not long in coming. For in the same year, 1912, that the book was published, occurred the famous discussion in the rooms of Dr. von Laue at Munich—where the University at that time included in its scientific coterie Röntgen, Groth, Sommerfeld, and Ewald—which resulted in the epoch-making experiment being tried by the two assistants, Friedrich and Knipping, of passing X-rays through a crystal and receiving the issuing rays on a photographic plate. Not only did this successful experiment fulfil the suggestion of Dr. von Laue, that the differently orientated parallel series of planes of atoms composing a crystal should act as a space-grating towards X-rays, which latter on reflection should afford some indication of the crystal symmetry, but also at once decided that the X-rays were of an undulatory nature, with wave-lengths of the same order as the dimensions of the chemical atoms.

THE time was indeed ripe for this pioneer experiment, the forerunner of all the subsequent immense work on the X-ray analysis of crystals. For crystallographers had settled in detail the types of symmetry possible to crystals, together with their space-lattices and point-systems (regarding the atoms as points), and had even got so far in the cases of definitely related (isomorphous) compounds, as to determine the relative volumes and dimensions of the unit cells of these three-dimensional lattices. Immediately after the publication of the first results of the Laue method, Sir William Bragg, then our leading authority on X-rays, took up the investigation, and, by devising a new spectrometric method in which the photographic plate was replaced by an ionising chamber mounted like the telescope of a goniometer, converted the qualitative results into actual measurement of the spacing of the parallel planes of atoms corresponding to each of the chief crystal faces, thereby fixing the absolute dimensions of the lattice-cells and the distances separating contiguous atoms, from centre to centre. The location of the atoms in the structure, and the number of molecules, if more than one, contained in each cell, followed naturally.

DURING his tenure (1915–23) of the Quain chair of physics in the University of London, Sir William Bragg published a brilliant series of papers in which the structure of a large number of crystallised substances was unravelled, at first mostly simple binary compounds, but afterwards more complicated substances, including several organic compounds. Still more recently, at the Davy-Faraday Laboratory of the Royal Institution, after Sir William had succeeded Sir James Dewar as Fullerian professor (1923), the list has been considerably extended, with the aid of an able school of research workers which he has gathered around him. Moreover, it is especially interesting that his distinguished son, Prof. W. L. Bragg, should also be carrying on the good work in the Department of Physics at the University of Manchester, after having assisted in numerous papers in clearing up the theory of this remarkable action of X-rays with regard to crystals. The joint book of father and son, "X-rays and Crystal Structure," now in its fifth edition, is a worthy record of the combined results achieved.

SEPT. 3 is the bicentenary of the birth of the well-known British manufacturer, Matthew Boulton, the partner of Watt and one of the leading industrialists of the eighteenth century. Boulton was born in Birmingham, and at the age of twenty-one years he became a partner in his father's business of trinket making, which ten years later he inherited. His marriage in 1762 with Ann Robinson, of Lichfield, brought him a fortune of £28,000, and the same year he began the building of the historic Soho iron works. By 1767 his turnover was no less than £30,000 per annum. He had by then become acquainted with Watt, and from that acquaintanceship sprang the partnership which made Boulton and Watt the great pioneer firm of steam-engine makers and mechanical engineers. Soho Foundry became the training ground for the new profession. The two men were strangely unlike in temperament, and nowhere could Watt have found another better fitted to further his efforts and support him in bringing the new steam engine into use. With an optimistic outlook on life, endless tact and perseverance, a sound judgment of men and unusual powers of organisation, Boulton possessed a wide knowledge of the world and its industries. The partnership began in 1775. In the next ten years Boulton had raised and expended no less than £40,000 before the steam-engine business began to pay, and Watt himself afterwards wrote "that to his friendly encouragement, to his partiality for scientific improvements and his ready application of them to the processes of art, to his intimate knowledge of business and manufactures and to his extended views and liberal spirit of enterprise, must in a great measure be ascribed whatever success may have attended my exertions." Boulton himself made great improvements in the art of coining, while his scientific attainments led to his election to the Royal Societies of

London and Edinburgh. He died in 1809, ten years before Watt, and his grave is, like Watt's, in Handsworth Church.

UNDER the auspices of the University of Berlin, a 'Ferienkursus für Ausländer' was held in the Physical Institute on July 2–21, the object being to bring before research workers outside Germany the latest results and—to some extent—the speculations of theoretical physics. How greatly this idea was appreciated may be gauged by the fact that an audience of seventy-five, representing fifteen different nationalities, listened to the lectures which had been arranged. The visitors were welcomed at the opening session by the Rector of the University and by Prof. Max Planck. Very unfortunately, Prof. Einstein was ill, and therefore unable to deliver his promised lectures. The speakers and their subjects were as follows:—Prof. v. Laue, theoretical optics and X-rays; Dr. Reichenbach, space-time theory; Prof. Schrödinger, wave-mechanics; Dr. Ladenburg, dispersion; Prof. Hettner, radiometer: breadth of spectral lines; Dr. v. Mises, probability: aerodynamics; Dr. Becker, electron theory of metals; Dr. v. d. Pahlen; stellar statistics; Dr. Bothe, radiology; and Dr. Czerny, infra-red research.

OPPORTUNITIES were afforded during the meeting for seeing something of the original work in progress in laboratories of the University of Berlin, under the guidance of Profs. Nernst, Wehnelt, Pringsheim, and Dr. Lange, whilst a large party availed themselves of the invitation to visit the Reichsanstalt and to listen to an interesting account of its history by Prof. Paschen. This constituted the first course of its kind ever attempted in Berlin, and was regarded in some respects as an experiment. It is difficult to imagine that it could have been more successful either in its scientific value or in the organisation for the comfort and convenience of those who came from considerable distances to hear the words of wisdom. Perhaps in future years similar courses may be arranged in other branches of knowledge. Meanwhile, all who had the chance of being present at the first 'Ferienkursus' this summer departed under a deep debt of gratitude to their hosts for such an opportunity of hearing from the authors themselves of the latest advances which they have made in theoretical physics.

As an effort towards the co-ordination of the extensive new information regarding the geology of Asia, a discussion has been arranged during the British Association meeting in Glasgow on Tuesday, Sept. 11, upon the structure of Asia. The first paper, by Prof. F. E. Suess, of Vienna, "The European Altaids and their Correlation with the Asiatic Structure," will explain some modifications which he regards as necessary in his father's synthesis of Asia. Prof. D. I. Mushketov, director of the Russian Geological Survey, will contribute an account of the recent work of Russian geologists in Eastern Turkestan. The remarkable results obtained in Persia and Mesopotamia by the staff of the Anglo-Persian Oil Co. will be announced in a paper, "A Contribution to the Stratigraphy and Tectonics of the Iranian Ranges," by Dr. H. de Böckh, Dr. G. M. Lees, and Mr. F. D. S. Richardson. Prof. G. B. Barbour, of the University of Peking, will give an account of the work by himself, the Chinese Geological Survey, and of the American geologists, Prof. Berkey and Mr. Morris, during the recent Mongolian expedition, dealing with the mountain structure of north-eastern Asia. Prof. J. W. Gregory will summarise recent work in south-eastern Asia. It is hoped that Prof. Brouwer will speak on the mountain structure of the East Indies, Prof. Boswell on some recent views regarding the cause of the Asiatic movements, and Sir Thomas Holland and Mr. W. D. West on work by the Indian Geological Survey on the structure of the Himalaya.

MANY interesting facts are brought out in the Registrar-General's Statistical Review, 1927, Part I. (Medical Tables), dealing with vital statistics of Great Britain, which has recently been issued (London: H.M. Stationery Office, price 15*s*.). The birth-rate for the year 1927 was 16·6; this is the lowest birth-rate recorded since the establishment of civil registration in the country, the lowest rates previously being those for 1918 (the last year of the War), and 1926, which were 17·7 and 17·8 per 1000 population respectively. The death-rate was 12·3 per 1000 population, which is slightly higher than for any year since 1922. The rise affects the two sexes almost equally, and was due to a severe epidemic of influenza in the March quarter. The deaths of infants less than one year of age were equal to 70 per 1000 births, being the same as for the previous year. Thus the two years 1926 and 1927 have the lowest infant mortality rate on record except only that for 1923, which was 69. The mortality from the infectious diseases differed little from that for the previous year, except that the deaths from influenza numbered 22,263 and were equal to a rate of 567 per million living, which is the highest recorded since the great epidemic of 1918–19. The death-rate from cancer was 1376 per million population, or 14 per million higher than in 1926, and was the highest crude death-rate yet recorded. Increasing use is being made of lysol and coal gas as means of self-destruction; whereas the registered deaths by lysol and coal gas poisoning in 1919 were 7 and 213, in 1927 they increased to 361 and 994 respectively.

THE bird sanctuaries in the Royal Parks in and about London have now been established for nearly six years, and during that time they have been effective in increasing the numbers of nesting birds in certain much-frequented places, and in focusing the interest of many people upon the varied bird life of a great city. The Annual Report of the Committee on Bird Sanctuaries, Royal Parks, England, for 1927, shows that the Committee is not neglecting the condition of the shrubberies, a vital matter if the nesting and sheltering of the birds are to be kept at a high frequency. This and the replacement of worn-out nesting boxes completes the active efforts of the Committee as here recorded. The remainder of the report consists of separate accounts of the bird life of each of the great parks, by various observers. Many of the observations can only be regarded as

trivial, but on the whole they indicate that both summer visitors and nesting birds were scarcer in the sanctuaries in 1927 than in previous years. A word may be said about the format of the report. It is duplicated by a type-writing process on paper of foolscap size, so that instead of being kept for reference it is more likely to be thrown into the waste-paper basket when read. Many visitors to the parks would appreciate this guide to the bird inhabitants, were it printed in a size suitable for library shelves, for one of the chief interests of the annual reports must always be the comparison of one year's results with those of its predecessors. The cost of printing might well be lessened by the reduction of some of the special reports, and the bird sanctuaries should afford opportunities for very attractive illustrations.

AN apposite illustration of a reference to the connexion between twins and the sky among primitive people in our Calendar of Customs and Festivals under date Aug. 18 (see NATURE, Aug. 11, p. 224) is contained in a dispatch from the *Times* correspondent at Buluwayo which appears in the issue of Aug. 17. Two cases were before the Courts on the previous day in which natives were tried for the murder of twins in accordance with native law. It was stated that the native belief was that to kill twins was to secure a good rainfall. The accused were not the parents but the grandparents and a mother-in-law; but in one case the mother acquiesced, nor had she fed the children since their birth as it was against native law. Sentence of death was passed, but the judge stated that it was not likely to be carried out. It may be remembered that a case of human sacrifice during a drought to secure rain occurred a few years ago in one of the South African tribes, when the son of a chief was killed. The present case differs in some respects. It was customary among most African tribes that one or both of twins should be killed at birth, especially if they were girls. This, however, was a rain charm in the sense that it was intended to *avert* the misfortune, especially drought, which their birth entailed. The Rev. H. Junod records that among the Bathonga, a tribe of north-east Rhodesia, twins, who were called the Children of Heaven, though no longer killed, required that not only the mother but also the community should be protected from the evil effects. Twins being specially connected with heaven, their birth prevented rain from falling. It was therefore essential that they should be buried in wet ground. In time of drought, water was poured on their graves, and if they had been buried in dry ground the Bathonga even went so far as to dig up the bodies and rebury them near the river.

THE monthly review edited by the Verband Deutscher Elektrotechniker and two other German institutions, the English edition of which is called *Engineering Progress*, gives in the March issue an excellent description of the huge Klingenberg electric power station near Berlin. The entire number of the journal is devoted to a description of the station, the object being, it is stated, to emphasise the importance of high-class engineering work in the sphere of electric power supply. The power station is situated on the Rummelsburg lake on the outskirts of Berlin and covers an area of fifty acres. It borders on the River Spree, from which even during a hot summer ample cooling water can be obtained. The thermal efficiency of condensing turbines increases with the degree of superheating and in a less degree with the pressure of the steam. On the other hand, the durability of the materials is affected by very high temperatures. A temperature of 400° C. (570° F.) has been chosen at the turbine, the temperature at the boiler outlet being 410° C. The pressure in the boiler is about 500 lb. per sq. inch and in the turbine about 460 lb. By preheating the air before it enters the furnace, it is calculated that an annual saving of about £10,000 per machine is effected. Pulverised coal firing is adopted. An interesting novelty is the drying of the coal by steam, each dryer being sufficient for 25 tons of coal per hour. The pulverised coal is conveyed by means of pipes to the boiler-house, the longest pipe being 1150 feet. Each steam turbine has a capacity of 80,000 kilowatts. The electric energy is generated at 6 kilovolts, is converted to 30 kilovolts and supplied to the networks of greater Berlin. A striking feature of the station is a very lofty building containing the administration offices. It has ten storeys, and on the top of the building are three large water tanks capable of supplying the station with water. In this building are recreation rooms for the station staff, a lecture hall, and a telephone exchange.

BY an Order of the Committee of Privy Council, Prof. Robert Muir, Sir John Herbert Parsons, and the Right Hon. Sir Charles Philips Trevelyan, Bart., M.P., have been appointed members of the Medical Research Council into the vacancies caused by the retirement of Prof. Georges Dreyer, Sir Archibald Garrod, and the Right Hon. William Graham, M.P. The new appointments become effective on Oct. 1.

THE one hundred and ninth annual session of the Swiss Society of Natural Sciences is being held at Lausanne on Aug. 30–Sept. 2. The programme includes general lectures by Prof. E. Bosshard (Zurich) on the past and future of the wholesale chemical industry; Prof. P. Termier (Paris) on recent impressions of travel; Prof. M. Askanazy (Geneva) on achievements and aims in the study of tumours; and Prof. A. Reymond (Lausanne) on the occult sciences in antiquity, a methodological study.

THE Council of the National Institute of Agricultural Botany has awarded the Snell Memorial Medal for the year 1927 to Prof. Paul A. Murphy, professor of plant pathology at University College, Dublin. The medal is given annually to mark eminent work in the sphere of potato husbandry, and it has been awarded to Prof. Murphy in recognition of his valuable contributions to the study of the virus diseases of the potato.

WE have received from Messrs. H. K. Lewis and Co., Ltd., of Gower Street and Gower Place, London, W.C.1, a selection from the "Catalogue of Medical Works" published by them; also a pamphlet entitled

"Eighty-Four Years, 1844–1928," reviewing the activities of the firm since its foundation. These include the publication of many works of medical and scientific interest by well-known authors; a book-selling department, which includes an agency for the supply of standard American and continental works; and a second-hand book department, which contains one of the largest collections in Great Britain of standard and recent works in medicine, surgery, technology, and general science, scarce books when not in stock being advertised for without charge. Finally, there is the circulating library, which contains about 30,000 volumes in all branches of medicine and the allied sciences, as well as books of general scientific or philosophic interest. Attached to the library is a reading and writing room for the convenience of subscribers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A forestry inspector, Department of Lands and Agriculture, Irish Free State—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (Sept. 4). A full-time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 7). A lecturer in engineering science for automobile engineers at the Polytechnic, Regent Street—The Director of Education, The Polytechnic, Regent Street, W.1 (Sept. 7). An assistant lecturer and demonstrator in electrical engineering in the University of Sheffield—The Registrar, The University, Sheffield (Sept. 14). A pathologist and lecturer in pathology in the St. George's Hospital Medical School—The Dean of the Medical School, St. George's Hospital, S.W.1 (Sept. 15). A professor of physiology in the Patna Medical College—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 19). A professor of mechanical engineering in the Bengal Engineering College, Sibpur—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Sept. 19). The Radcliffe Crocker Travelling Scholarship in Dermatology of University College Hospital Medical School—The Dean, University College Hospital Medical School, Gower Street, W.C.1 (Sept. 30). The William Julius Mickle Fellowship of the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (Sept. 30). A permanent physicist to the Cancer Research Committee of the University of Sydney—The Registrar, The University of Sydney, Sydney, N.S.W. (Nov. 15). A professor of tropical medicine at the Calcutta School of Tropical Medicine and Hygiene—The Director, School of Tropical Medicine and Hygiene, Central Avenue, Calcutta. A pathologist and bacteriologist under the Kensington Board of Guardians—The Clerk to the Board, Guardians' Offices, Marloes Road, Kensington, W.8. Civilian education officers in the Royal Air Force Educational Service, preferably with practical qualifications for teaching engineering subjects—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1.

Our Astronomical Column.

WHAT BECOMES OF THE STARLIGHT?—This is the title of an interesting article by Prof. H. N. Russell in the *Scientific American* for August. Prof. Russell points out that, on the old conception of boundless space, by far the larger portion of the energy poured forth from the stars would seem to be dissipated in the form of ever-widening and ever-weakening waves. On the conception of re-entrant space, the waves would, after making the circuit of space, go over the same ground again. The question is examined whether the wave energy, which is now considered to come from the annihilation of matter, may possibly be built up into matter again. It is shown that this involves some difficult conceptions. The energy required to form a hydrogen atom would be spread through some 400 cubic feet of space. A reference is made to Dr. Millikan's suggestion that the cosmic rays investigated by him result from the union of 28 hydrogen atoms to form a silicon atom; "it is not easy to see how the 28 electrons and 28 protons can all get to the same place at the same time." But it must be remembered that knowledge of the structure of the atom is only a quarter of a century old, and it is to be hoped that the future may reveal solutions of these difficult but fascinating problems.

DOUBLE STARS MEASURED AT JOHANNESBURG.—Vol. 14, part 4, of the *Annals* of Leyden Observatory contains the measures of double stars made with the new 26½-inch refractor and the 9-inch refractor at the Union Observatory at Johannesburg, by W. H. Van Den Bos, between the dates 1925.6 and 1928.2. The search was a systematic one, the sky south of decl. −19° being swept over, and all stars examined down to the limiting magnitude 9·0 of C.P.D. The result for the region at present covered shows that one star in 16 is double within Aitken's limit of distance, which is 5″ between magnitudes 6 and 9. The power used in sweeping was 420, and the observer notes that he was able to detect the duplicity of stars too close to divide with this power by the blurred character of the diffraction image. The sweeps were made without previous consultation of double-star catalogues, so that the search is quite unbiased, but some known objects might be missed through being near periastron. Several cases of wrong identification in previous catalogues are noted, and it is suggested that in such cases the first to give the right identification has the claim to the discovery.

There are a large number of very close pairs in the catalogue, and many of these are likely to show orbital motion within a few years. Close pairs with equal magnitudes need continuous watching, otherwise there is danger of confusing the quadrants. It is stated that Doberck and Dawson have done this in the case of γ Centauri, and that the period is only half that given by Dawson.

A very interesting triple system is C.P.D. −30° 181; the wider pair has moved through 110° since its discovery by Burnham; the brighter star has a closer companion, discovered by Dawson, the period of which is stated to be less than five years, which is probably the shortest of all visually discovered binaries. The present catalogue contains 141 pages, there being about 11 pairs on each. They are mainly between −19° and −30°, but there are several outside these limits, Castor being included.

Research Items.

AFRICAN HOE CULTURE.—Dr. Hermann Baumann publishes in *Africa* for July a contribution to the study of primitive economics in the form of an analysis of the division of work according to sex in the use of the hoe in African methods of cultivation. It was for long held that the exclusive use of hoe culture by women was proof that agriculture and the settled life were the invention of the woman, who thereby acquired legal and social ascendancy, while man only took part in the tilling of the soil with the introduction of the plough. Now, however, a higher form of hoe culture is recognised in which the man takes a part. It is still associated with matriarchy, but operates in the larger family. In Africa there are two large groups of hoe cultivators. One in the Sudan, Central East Africa, and the highlands of Angola, shows men's work to a greater or less extent, with intensive cultivation; the other, mainly on the west coast, with branches extending to the east coast, in which, except for clearing the ground, the work is left exclusively to the women, and the cultivation is non-intensive. In nearly all cases where cultivation is by men and intensive, it is associated with the older form of patriarchy, the older kinds of African grains are used, government is associated with the ownership of farms, and inheritance is the right of the elder brothers. Cultivation by both sexes, with a preponderance of male labour, is characterised by the fact that the men who mainly grow grain still retain in their processes of hoe culture much of the older root cultivation methods of the women. The rough work, digging, making beds and mounds, is the work of the men; weeding is done by the men when the hoe is exclusively the man's tool. In sowing, the man makes the hole for the seed, the woman puts it in, while at harvest the men dig up the roots, and the women carry or cart the corn. Each sex has its special crop. The evidence from Africa thus tends to confirm the theory that the culture of root crops associated with female labour is the most ancient, and that female labour is associated with matriarchy.

SLAB-BUILT GRAVES IN THE MALAY PENINSULA.—A grave built of granite slabs, with which three carnelian beads were associated, was found in Perak in 1895. A subsequent examination by Mr. H. C. Robinson produced a cross-hatched stone bark-cloth beater, some fragments of bronze, pottery, and an iron tool. Three additional graves of this type discovered at Sungkai in 1927 have been excavated by Mr. I. H. N. Evans, who publishes a report on them in vol. 12, pt. 5, of the *Journal of the Federated Malay States Museums*. In their essentials the graves are comparable to the dolmen, though outside these cists the only megalithic monuments discovered in the Peninsula are those at Pengkalan Kempas, Negri Sembilan. No human remains have been found, and it is not, therefore, possible to arrive at any conclusions as to the race by whom they were constructed, except that they are the work of a race, possibly of tinworkers, who occupied at least part of the peninsula. The graves are of considerable size, three metres in length or just under, and as no granite occurs nearby, their use must have involved considerable labour. The iron tools which were in use were of a peculiar type, some having very small sockets for the insertion of a handle in the same plane as the blade. Stone quoits, though not found in the graves, were probably contemporaneous with the cross-hatched cloth-beaters. A number of bronze implements were also found. Pottery was rough in type and handmade. Patterns were not common; but both inside and out, the pottery was covered with some glaze-producing material. On the authority of Dr. P. V. van Stein Callenfels, it is stated that cists and graves of the dolmen type are not uncommon in Java, extending from the neolithic to the iron age.

TOBACCO SMOKING IN GREAT BRITAIN.—The smoking habits of the people of Great Britain have undergone considerable changes during the past two decades, according to a report of the Imperial Economic Committee (Ninth Report, Tobacco, Cmd. 3168. London: H.M. Stationery Office). There has been a considerable increase in the consumption of tobacco, which has risen from 2·4 lb. *per caput* in 1914 to 3·4 lb. in 1927. The increased consumption would appear to be due "to the extension of the cigarette habit and to smoking on the part of women." Only in a few countries is the average consumption greater than in Great Britain (Belgium 6·6 lb. a head, U.S.A. 6·02 lb., and Germany 4 lb.). Another interesting feature has been the change over from pipes to cigarettes. In 1907 only 24 per cent of the tobacco consumed in Britain was smoked in the form of cigarettes, but by 1924 the percentage had risen to 58. There has been a marked increase in the demand for Empire tobacco, and considerable improvements in its quality have been effected. In 1924 the Empire supplied only 3·3 per cent of the leaf tobacco imported into Britain, but by 1927 the figure had risen to 18·4 per cent. It is estimated that 37 per cent of the pipe tobacco consumed in the United Kingdom consisted of Empire leaf, but that only 1 per cent of cigarette tobacco was Empire grown. The greatest field for expansion in Empire tobacco marketing is therefore in cigarette tobaccos. It is essential, however, that attention should be paid to type and quality. Distinctive types of tobacco tend to retain their aroma even under marked changes of environment, and to that extent flavour may be regarded as heritable. Nevertheless, the soil and climatic peculiarities have a great influence. Efforts should be made to adapt the flavour of Empire tobaccos to the established taste of the public, and for this purpose the Committee recommends research into the nature of aroma.

EFFECT OF DROUGHT UPON BIRD LIFE.—The long-continued and disastrous drought experienced by central-western Queensland during the past few years has had notable repercussions upon bird-life. During the past three years the total rainfall has been 17½ inches, whereas a forty years' average would indicate 4 feet. Consequently insects, seeds, and berries have been scarce, and birds have suffered from lack of food. Some of the results described by F. L. Berney (*Mem. Queensland Mus.*, vol. 9, pt. 2, 1928) are unexpected. For example, it was discovered that all birds ceased to nest: "from the middle of February 1925 to the latter part of June 1926, a matter of nearly seventeen months, I saw absolutely no evidence of any bird nesting. Even the Corvidæ, birds that one would think would rather revel in hard times with so many dead animals about, were not nesting, but that is perhaps to their credit, indicating that they require not carrion but a variety of insects on which to rear their nestlings," a suggestion which indicates either remarkable instinct or foresight on the part of the crows. Following upon two inches of rain in May 1926, the author noted about a dozen nests belonging to seven species of birds. The high fencing of the country added to the distress, for it prevented the possibility of the migration of emus to more favourable

localities, so that on many holdings these fine birds have been exterminated. The bird population has thus been seriously affected not only by actual deaths, but also by the absence of potential broods.

A NEW AQUARIUM MICROSCOPE.—With the view of observing aquatic microscopic organisms under conditions approaching as nearly as possible to their natural surroundings, Mr. D. J. Scourfield has devised a new type of aquarium microscope (*Jour. R. Micr. Soc.*, June 1928). At the lower end of the body tube of this instrument is a water-tight casing, containing a right-angled prism, to which is attached another casing also containing a right-angled prism, and this second casing serves as the carrier of the low- and medium-power water immersion objectives employed. The combinations of movements possible with the two casings, together with the raising and lowering of the tube and the traverses in two directions in a horizontal plane, enable the objectives to be turned in any direction in the aquarium. Mr. Scourfield points out the probable interest of observations from below or from the side on organisms which make use of the surface film.

SUBTERRANEAN CRUSTACEA.—This formed the subject of the presidential address to the Quekett Microscopical Club (*Jour. Q.M.C.*, vol. 16, 1928) by Dr. W. T. Calman. He urged the amateur microscopist to be on the watch for well-shrimps and other subterranean crustacea, for the amateur who is content to wait but is able to take advantage of the opportunity when it arrives, may obtain results which the professional worker sighs for in vain. The well-shrimps, *Niphargus*, seem to be confined to the southern counties of England, but the common species, *Niphargus aquilex*, occurs as far north as Norfolk. It is not clear how many species of *Niphargus* occur in England, nor has their distribution been exactly ascertained. No subterranean isopod has hitherto been recorded in England, but about two years ago Miss Lucas found in a well at Ringwood, in the New Forest, a blind isopod, *Asellus cavaticus*, which is known from several localities on the Continent.

DIPTERA FROM THE MALAY PENINSULA.—Flies of the sub-order Nematocera other than mosquitoes have hitherto been almost entirely neglected by collectors in the Malay Peninsula. In the *Journal of the Federated Malay States Museums*, vol. 14, part 1, 1928, Mr. F. W. Edwards contributes a lengthy paper on the Malayan Nematocera, which serves to give an idea of some of the genera and species that occur in that region. The material which he studied had recently been acquired by the Malay States Museums and was submitted by the late Director of that institution. At least half the species of all the families, other than mosquitoes, appear to be new to science, and were almost all collected by Mr. H. M. Pendlebury, entomologist on the staff of the museum. Among the fungus gnats, or Mycetophilidæ, only a single species was previously recorded from this region, and in the present paper 59 are recorded, 45 of which belong to the subfamily Sciarinæ, which is evidently strongly represented. The mosquitoes are tolerably well known and number 198 species, which is almost the same total as that recorded from the Indian Empire with Ceylon. There are, however, very evident differences in the Malayan and Indian mosquitoes, and less than seventy of the Malayan forms have been found in the Indian region, whereas nearly all the known Bornean mosquitoes also occur in Malaya. The Crane flies, or Tipulidæ, are also abundantly represented, and the 160 species in the present collection bring the total known forms to 175. As with the mosquitoes, the crane flies exhibit a much stronger facies with those of Borneo, Java, and Sumatra, than with the Indian forms. The Chironomidæ or midges are not included in this paper, while certain of the gall-midges or Cecidomyidæ have already been described by Mr. H. F. Barnes (*Jour. F.M.S. Mus.*, vol. 13; 1927).

EFFECT OF SULPHURIC ACID ON COTTON SEEDS.—The process of treating cotton seeds with sulphuric acid for the purpose of delinting has involved a number of questions, including the effect of the treatment on germination and the sterilising effects on the seeds. Prof. V. H. Blackman undertook to investigate the treatment for the Cotton Growing Corporation, and his report is published in a recent issue of the *Empire Cotton Growing Review* (vol. 5, No. 3). The germinating power of seeds soaked in concentrated sulphuric acid and in dilute acid has been compared with that of controls soaked in water only, and the results are based on the examination of 11,000 seeds. After treatment for 20 to 30 minutes in strong acid, there was no clear evidence of definite increase or decrease in germinating capacity and no evidence of any injurious action. In the case of both the acid-treated seeds and the controls, germination was as complete after four days as after six. With acid treatment there was, however, earlier germination, the second-day results being higher after acid treatment. An exposure to strong acid for so long a period as six hours had no injurious effect on the sample tested, and complete delinting was attained in four hours. The method of wetting the seeds thoroughly with weak acid and then allowing them to dry, thus concentrating the acid remaining on the seeds, was found to be unsatisfactory. The seeds were not delinted, besides suffering a serious reduction in their germinating capacity. It seemed possible that if treatment with strong acid had any detrimental effect on the viability of seeds, it might be due to rise in temperature associated with the treatment. The rise in temperature when the acid comes in contact with the small quantity of water in the seed coat was, however, found to be slight. It is suggested that during the process of washing, local heating of individual seeds may occur as the result of combination of water with acid absorbed by the seeds.

LAND SHELLS OF THE GALAPAGOS ISLANDS.—Numerous collections have from time to time been made of the land shells of the Galapagos Islands, and a record of these was given by Dr. Dall in his admirable paper on "Insular Landshell Faunas" (*Proc. Acad. Nat. Sci. Philad.*, 1896), but the most extensive collection yet appears to have been that made during the expedition sent out by the California Academy of Sciences in 1905–6. Owing to delay in publication some preliminary descriptions of the new species were issued by Dr. Dall in 1917 (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 2). The complete report, however, by Dr. Dall and W. H. Ochsner (both, alas, no longer with us) has now appeared and forms a most valuable communication (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 17). The authors give a summary of the environmental conditions and the habits of the land shells, followed by a scheme of the groups or sections, some of them new, of the Bulimuli, as well as a check list and insular distribution of all the known Galapagos land shells, totalling 78, in alphabetical order. The remainder of the paper is devoted to the descriptions of 59 of these, mostly belonging to the genus *Bulimulus* and none of them new, whilst the more important are figured on two good photo plates. The whole is a noteworthy contribution to the fauna in question and likely long to remain a standard work of reference.

ORGANIC CONSTITUENTS OF OIL SHALES AND RELATED ROCKS.—The latest contribution to this theme comes from Miss Jennie Livingstone of the University of Colorado, published in vol. 16, No. 2, of the *Studies* of that institution. Her work covers microscopical investigations and chemical experiments, reinforced with the usual sketch of shale industrial history and a résumé of the researches of different international workers. The photomicrographs are, however, very good, and the drawings of Green River shale and Kentucky cannel, especially the sporangium covering in the former, are reproduced in colour and are accordingly most instructive. The results of the work support the general theory of organic origin of oil shales, differing specifically in the nature of the original vegetable matter entombed in the sediments, and in the subsequent modifications which such matter has undergone. The environment of accumulation is pictured as swamp, marsh, or lagoon, and bacterial action is indicated by the predominance of humic material in most of the thin sections examined. Further, specific types of organic constituents probably control the nature of the distillates furnished by various types of oil shale, hence recognition and differentiation of such constituents might be expected to form the best basis of philosophical classification of these pyrobituminous rocks. This is, as a matter of fact, so far as most current researches get, but it is the next step which is the most difficult of all. It is not enough to arrive at a classification which, after all, is merely an aid to description; what we would like to know is the mechanism of the complex change whereby the organic matter is converted into 'kerogen,' exactly what principal factors control the destiny of that 'kerogen' when subjected to destructive distillation, and precisely why it is that different ranges of products are produced not only according to the varied shales used but also in response to different conditions of distillation.

THE DAILY VARIATION OF TERRESTRIAL MAGNETISM.—The July issue of the *Physical Review* contains a paper by Mr. Ross Gunn, of the Naval Research Laboratory of the United States, in which it is pointed out that the properties of the conducting layer of the atmosphere are not such as to lead to the large electric currents originally suggested by Balfour Stewart and utilised by Schuster and by Chapman in their examinations of the origin of the daily variation of terrestrial magnetism. Mr. Gunn shows that at the altitude of this conducting layer, where the free paths of the ions and electrons are long, the conductivity is anisotropic and is zero in the direction of the impressed electric field, and the resulting currents in the direction of the field are small. The ions and electrons move spirally about the lines of the magnetic field and produce a diamagnetic region in the higher atmosphere facing the sun, the effect of which is shown to be of the order of the observed diurnal variation. The semi-diurnal and lunar variations and the existence of disturbed days are also explained in a general way by the new theory.

HISTORY OF THE DYNAMO.—In connexion with the fiftieth anniversary of the "world's first tests of the dynamo," interesting reminiscences are given in the *Journal of the Franklin Institute* for July by C. F. Brush, the inventor of the arc light dynamo, and Elihu Thomson. Brush relates how he first tested his dynamo in a sawmill, using a team of horses to get the required power. He excited his dynamo with a single battery, and he relates his joy when the machine suddenly began to develop electric power and the horses were nearly brought to a stop. It is interesting to remember that even in those days Deschanel's "Natural Philosophy" was regarded as a standard authority on electricity. In 1880 the Brush system of electric lighting was exploited in Great Britain and throughout Europe, a factory being equipped in London. The unit of electric current was then called the 'weber.' It was not until the International Conference in Paris in 1881 that the 'ampere' was officially adopted. In the early days, Brush made all the requisite working drawings himself, and also all his special testing appliances. It was a 'one man' laboratory. He wrote all his own patent specifications and tested and personally adjusted all his lamps and dynamos. Elihu Thomson carried out the tests on dynamo machines for the Franklin Institute in 1878. The lack of instruments made it necessary to improvise all kinds of methods of making measurements. He relates that the Committee of the Senate in 1900 which advised the establishment of the Bureau of Standards at Washington, took into consideration papers by Lord Kelvin and Prof. Snyder in arriving at their decision. So far back as 1881, Elihu Thomson had observed curious high frequency phenomena, and in 1889 he constructed a high frequency alternator.

THE PHOSPHORESCENT COMBUSTION OF SULPHUR.—At a temperature just below the ignition point, which varies with conditions from 285° to 325°, the oxidation of sulphur is accompanied by a bluish-white luminescence so long as heat is supplied. The reaction taking place at this point has been investigated by H. J. Emeléus with a view to search for any oxide of sulphur more volatile than sulphur dioxide, and his results are given in the *Journal of the Chemical Society* for July. The reaction products were condensed by cooling with liquid air and then carefully fractionated. No evidence of the formation of sulphur monoxide was obtained, and it was concluded that the reaction during the phosphorescent combustion of sulphur is the same as that in the normal flame. The formation of ozone in the glow, reported by Bloch, could not be detected. The slow luminous oxidation of sulphur appears to be a gas reaction and is sensitive to the presence of sulphur dioxide and various organic vapours. It is suggested that inhibition of the phosphorescence is the cause of the rise in the ignition point of sulphur produced by the presence of these substances.

CATALYSIS BY WATER.—During the course of an investigation of the fluorescence of mercury vapour, which is described in the issue of the *Philosophical Magazine* for August (p. 271), Prof. R. W. Wood and Dr. Gaviola have been able to show the precise part played by water in a chemical reaction catalysed by it. The reaction in question was the photochemical formation of mercury oxide from its elements at low pressure, under the influence of the ultra-violet light from a mercury arc. In the presence of a trace of water vapour, this proceeded with such rapidity that it could probably have been used to measure the rate of evaporation of mercury from a liquid surface, but when water was absent the oxidation did not occur. Nitrogen acted in the same way as water, but was less efficient. Simultaneously, water or nitrogen was found to change a large number of the optically excited mercury atoms from the 2^3P_1 state into the metastable 2^3P_0 state, in which they would accumulate. The conclusion reached was that for oxidation to take place, the mercury had to be excited to this particular metastable level, and that the energy of the metastable atoms was probably the real catalyser of the reaction. The method used by the authors to detect the presence of mercury atoms in their various states was characteristically neat, consisting in an interferometric examination of the appropriate lines from a mercury arc for reversal of their cores after passage through the reaction vessel.

Timber Research.

THE reception by Lord Balfour on July 31 of a large and representative gathering at the Forest Products Research Laboratory, marks a definite stage in the development of timber investigations under the Department of Scientific and Industrial Research. Previously accommodated in temporary premises at the Royal Aircraft Establishment, Farnborough, the Laboratory is now in full working order in admirably equipped and well situated buildings at Princes Risborough, Bucks. A photograph of the timber mechanics hall is reproduced in Fig. 1, which gives an idea of the kind of equipment installed in one of the buildings.

Particularly during the War, and following on the demands of aircraft manufacture, the dearth of scientific knowledge of timbers was very manifest. Valuable information was obtained by the Materials Section, under Prof. Jenkin, of the Technical Department of the Aircraft Production Department of the Ministry of Munitions. The threat of a world timber shortage after the War called for urgent action, not only to increase supplies by fresh plantings, but also to promote the utmost reduction of avoidable waste in the uses to which timber is put. It is with the second objective that the Forest Products Research Laboratory is mainly concerned.

For the Laboratory to function effectively, the problem has to be studied intensively from many aspects—pathology, timber physics, wood chemistry, wood technology, seasoning, timber mechanics, wood preservation, wood working—and arrangements made for bringing the results home to the using industries and for encouraging their general application. In a sense, the successful meeting at the Laboratory on July 31 may be regarded as an important piece of 'utilisation work,' since the visitors were given opportunities of visiting the various laboratories, and the clear placarding and labelling of the exhibits enabled them to gain fair impressions of the general organisation and of the investigations in progress.

Mention has already been made of the various sections in which the programme of the Laboratory's work naturally falls. The general research work covers the study of decay caused by fungi and attacks by insects; the analysis of wood and its derivatives, effects due to seasoning, wood preservation, etc.; the examination of the relations of water and heat to wood. Then come problems such as the basic principles of seasoning; the evolution of appropriate mechanical tests and the interpretation of the results; antiseptic treatments against decay; which are subsidiary to full scale work on kiln design, strength comparisons, and wood preservation. In certain of these sections the Laboratory works in close association with the Forestry Commission, the Imperial Forestry Institute at Oxford, and with recognised authorities on particular subjects at the Imperial College of Science and Technology, University of St. Andrews, and the Imperial Institute.

Progress has already been made on a number of specific lines of investigation, and a description of some of them may be of interest.

An examination has been made of the decay occurring in Sitka Spruce timber. Several wood-destroying fungi have been isolated, and the principal one responsible for most of the decay has been identified as *Trametes serialis*. This fungus has been grown in pure culture and its life history studied. The method of attack on timber and the character of rot produced have been carefully observed. A full study of the physiology of the fungus, including the water relationships, is proceeding; in addition, it is proposed to determine the effects of the fungus on the mechanical strength of the wood after varying intervals of time.

Another interesting and important problem which has been attacked relates to furniture-destroying insects, notably *Lyctus* beetles. An investigation

Fig. 1.—Timber Mechanics Hall Forest Products Research Institute, Princes Risborough.

has been made into the losses caused by these beetles on timber in store. The work has reached a stage at which practical methods can be given for ridding the timber of this pest by a steam sterilisation treatment in the kiln. It has been shown that sterilisation is effected when the timber is maintained in the kiln for 1½ to 2 hours at an overall temperature of 130° F. and humidity 100 per cent. Apparently there exists a definite relationship between the diameter of the pores of a wood and its susceptibility to *Lyctus* infestation; when the diameter of the vessels of a wood are less than that of the *Lyctus* egg, it is not attacked by this insect. The moisture content of the wood is also a determining factor, and results to date indicate that infestation does not occur when the moisture content falls below 8 per cent. The experiments are being continued in order to ascertain whether lower conditions of temperature and humidity, combined with longer periods of treatment in sterilising kilns, cannot be used to kill *Lyctus* in all its stages. The next problem is to secure immunity for the timber from further attack. Any method, to be practicable, must not spoil the colour

of the timber, must be cheap and easily applied. Preliminary work on this aspect of the investigation is in hand.

An allied 'project' is concerned with the losses caused by Anobiid beetles on timber in buildings and in furniture. Two insects are being specially investigated—*Anobium punctatum* (Common Furniture beetle) and *Xestobium rufo-villosum* (Death Watch beetle). Detailed studies of the biology of both insects are in progress, and the mode of egg-laying and the rate of development of the larvæ are being determined. Later it is proposed to study the effect of varying temperatures and humidities on the length of the life-cycle of both species, and to ascertain whether preferences are exhibited by the insects for different species of timbers. It may be, also, that there exists some relationship between fungal infection of timber and progress of Anobiid attack.

Standard tests are being developed of antiseptics for use in wood preservation generally and in particular for preservation against insect and fungal attack. Timbers treated with various antiseptics at different concentrations are being exposed, and records of results will be kept over long periods.

Microscopic examination is being made systematically of wood structure. Much work is being carried out on the structure and identification of British hardwoods. The variation in structure of home-grown timbers is being studied as a necessary preliminary in forest products research problems. Work has been begun on elm, ash, and oak.

Another main line of experimental investigation concerns the factors influencing and controlling the movement of moisture and heat in timber, with special reference to their bearing on timber seasoning. Several methods of determining heat movement have been tested, and attention is at present being directed to thermal diffusivity as distinct from conductivity. As a result of the experiments carried out to date, considerable information has been obtained as to the rôles that temperature, vapour pressure, and rate of air circulation play in influencing the moisture movement in wood and in its drying. Two 'Technical Papers' on the subject have been published. The original intention was to proceed to estimate the effect of such factors as structure and density, in order to assess the seasoning qualities of different species of wood and to obtain data for optimum seasoning conditions. Recent experience is showing, however, that the problems of case-hardening, shrinkage, and collapse with related warping are of greater importance than was at first realised. Experiments are also in progress to determine the degree of hygroscopicity of different timber, with the view of ascertaining means of reducing the troubles arising therefrom.

An incidental problem is the determination of the most suitable moisture content for timber to be used in the manufacture of various kinds of furniture and in decorative work. Seasonal variations of moisture content in timber are under close observation.

The testing of the mechanical and physical properties of timbers naturally occupies an important part of the working programme of the Laboratory. Mention may specially be made of tests of small clear specimens designed to give a measure of the inherent fibre strength of the species and to provide a basis for comparing one species with another, for determining the influence of defects in larger samples, and for computing the effect of rate of growth, density, and moisture content. Fourteen consignments of home-grown timber have been collected, nine of which have been tested in the green condition, and four, air dry. More than 18,000 tests have been made.

Tests have been made of the seasoning and mechanical properties of timber used, or proposed for use, as pit props; it has been shown generally that home-grown species bear favourable comparison for the purpose to imported timbers. Mechanical tests have also been made of plywoods. In connexion with tests on structural timbers, preliminary data are being obtained for beams and joists; it is hoped in due course to evolve tables for structural grading, etc., which will be of great utility in specifications for building work.

Investigations are being made into the kiln seasoning properties of the commoner commercial timbers. Those into Corsican pine are completed; those into oak, beech, and common elm are proceeding. Parallel mechanical tests are also being made on kiln-seasoned material as compared with control samples.

Data relating to heat quantities and air circulation figures are being collected whenever possible, and observations are being made on the behaviour of the existing kilns, with a view to the construction of a special kiln for the study of factors influencing kiln design. A model experimental chamber is in operation. A report has already been issued regarding the essential principles of kiln seasoning of timber.

An interesting investigation has been carried out on the briquetting of charcoal manufactured in portable and semi-portable kilns, with the object of enabling the more profitable utilisation of waste timber in factories, etc. Following the production of satisfactory charcoal in the portable kilns operated at the Laboratory, arrangements have been made for briquetting trials on a commercial scale.

The above notes will serve to indicate the scope of the general programme of work of the Forest Products Research Laboratory. It should, however, be emphasised again that the scientific and technical work of the Laboratory is being linked as closely as possible with practice, and that continuous efforts are made not only to spread information as it becomes available, but also to arouse and maintain the active interest of the industry in new ideas and new operative methods for the economical utilisation of timber.

The Scott Polar Research Institute.[1]

By Dr. H R. MILL.

IN welcoming visitors from all the countries represented at the Congress to the temporary premises of the Polar Institute at Lensfield House, the committee of management trusts that the extreme youth of the Institute will be held to excuse the greater prominence given to hopes for the future rather than to memories of the past.

The Scott Polar Research Institute is neither a teaching body nor a society seeking a numerous membership. Its aims are to encourage polar research by supplying information and advice to intending explorers, affording opportunities for study and assisting in the organisation of expeditions, and for this purpose to concentrate in one place all existing knowledge of the polar regions and subject it to expert criticism and cataloguing; above all, to maintain communication with all polar explorers, investigators, and students without any restriction or qualification.

[1] Substance of address at a reception given by the Scott Polar Research Institute of the University of Cambridge to members of the International Geographical Congress on July 21.

It appeared to many of us that the period of polar martyrdom should have been closed long ago, and that a stand should be made against the absurd appraisement of the greatness of explorers by the magnitude of the sufferings they endured. It seemed to us that experience already sufficed to indicate ways of carrying on research in the polar regions with comparatively little risk and practically no suffering if only it were possible to collect such experience and subject it to critical analysis and to show how it could be applied practically. Many of us had deplored the haphazard management of successive polar expeditions and the absence of continuity between them, each expedition being created with infinite labour, carried out at great expense, and allowed to melt away.

The opportunity of remedying this unfortunate state of things arose out of the tragedy of Scott's last Antarctic expedition. The scientific staff which sailed on the *Terra Nova* had a cohesion lacking in previous expeditions. Coming when it did, the appeal of Scott's struggle to reach the pole, and his heroic persistence to the end in his fight against the unexampled difficulties of the way back, were irresistible, and a great wave of hero-worship raised a very large fund to provide for a worthy memorial of those who fell and for the needs of their dependents. The chief memorial was the working up and publication of the scientific results of the expedition, and when this was complete the Committee, composed of the president of the Royal Society, the president of the Royal Geographical Society, and the Lord Mayor of London, found themselves in possession of a balance of £12,000. Mr. Priestley and Mr. Debenham, of the *Terra Nova*, and Mr. Wordie, of the *Endurance*, all settled in Cambridge, persuaded the memorial committee to devote this sum to the establishment of the Scott Polar Research Institute, which came into existence in 1926, the University of Cambridge undertaking to administer the funds, of which £6000 was earmarked as a building fund and £6000 as a general fund, the interest of which is at present the sole income of the Institute. Mr. Debenham has been appointed director of the Institute, with Miss Drake as part-time assistant. To them we owe the admirable arrangement of the rooms which contain the collections now on view.

These consist of an Arctic room and an Antarctic room, each containing the nucleus of a library, with maps and relics of expeditions, other rooms with a good representation of the equipment for polar travellers and a fine series of photographs. These have been contributed by many friends, including the widows of Admiral Sir Albert Markham and of Capt. Scott. A special feature is made of MS. records and diaries of explorers, and anyone desirous of finding a permanent abiding-place for papers of this kind, or any other mementoes of polar expeditions, is assured of the grateful acceptance and careful custody of such treasures. In some cases the promise of handsome bequests has been made, and the steady growth of the library and photograph collection is assured.

An important aid in this direction is the possession of the whole stock of the reports of the *Terra Nova* expedition dealing with the geographical, geological, meteorological, and geophysical work. These volumes may be sold or given in exchange for the reports of other expeditions. A feature is made of the complete cataloguing of the collections.

The only condition imposed by the Scott Memorial Committee is that a suitable memorial building shall be erected before 1936, and in view of the present cost of building it is to be hoped that wealthy friends of geographical discovery will supplement the sum available, so as to make it possible to house the collections in a manner worthy alike of the memory of the great leader whose name it bears and of all he stands for as the best type of the naval explorer, worthy also of the University and of the spirit of research which makes scientific truth its only care.

The Institute, as yet, is in its days of small things, but its promoters dream great dreams of rapid growth and continual adaptation to the changing conditions of modern research. In particular, we cherish the ambition of attaining completeness in the library by securing all published works on the polar regions or transcripts of the relevant portions of such works as have become bibliographical curiosities of fictitious value in their original editions. As many works of exploration have been published without indexes, an effort must be made to supply an index for every published polar book, and a great general index which will embrace all polar literature. Similar completeness cannot be sought for the collection of gear and apparatus, in which models of ships and aircraft must necessarily take the place of the real things. The museum also would only aim at being an index collection with the leading types and full reference to the great museums in which a complete representation of species and specimens are to be found.

University and Educational Intelligence.

CAMBRIDGE.—Mr. R. B. Braithwaite, King's College, has been appointed University lecturer in moral science. Mr. T. R. B. Sanders, Corpus Christi College, has been appointed University demonstrator in engineering. D. R. P. Murray, Pembroke College, has been elected to the Benn W. Levy studentship in biochemistry. Miss W. L. P. Sargent, Newnham College, and G. R. Gedge, Trinity Hall, have been awarded senior studentships of the Goldsmiths' Company.

The readerships in the morphology of vertebrates and in estate management, vacant through the death of Dr. Gadow and the retirement of Mr. F. B. Smith, respectively, are not being renewed. The following teaching officers retire on Sept. 30 next: A. Berry, King's College, and H. W. Richmond, King's College, University lecturers in mathematics; T. K. W. Fair, Jesus College, University demonstrator in chemical physiology; and A. Hopkinson, Emmanuel College, University demonstrator in anatomy.

VOLUME 13 of the *Journal of the College of Technology, Manchester*, has 240 pages and 9 plates, 183 pages and the plates being devoted to original articles by the members of the staff, and the remainder to abstracts of papers which have been contributed by the staff to scientific and technological periodicals, mainly during the years 1925–1927, but a few in earlier years. Of the 13 original articles, 3 deal with mechanical, 1 with electrical, and 1 with civil engineering, 2 with textiles, 2 with mathematics, 3 with applied physics, and 1 with industrial administration. The abstracts number 64, and deal with subjects of the same type. With one exception the papers were set up and the whole journal was printed in the College, and reflects great credit on the printing department. The original articles and the abstracts show that the staff is making valuable contributions to the solution of the scientific and technological problems which arise in industry, and that the Manchester College of Technology retains its position in this respect as one of the best in Great Britain.

Calendar of Customs and Festivals.

August 30. ADDENDUM.

ST. FIACRE, hermit at Breuil, France (seventh century), venerated widely in France, Tuscany, Ireland, and Scotland. Born in Ireland of illustrious parentage, he early adopted a solitary life and, leaving Ireland, settled in the wood, Broilum or Brodolium (now St. Brié) in the diocèse of Meaux, where he healed the sick by the laying on of hands. He also devoted himself to gardening and became the patron saint of gardeners, who perform an annual procession in his honour on Aug. 30, both at Breuil and at St. Vaugirard in Paris, when both the churches are elaborately decorated with flowers. Few saints in France are more highly honoured, and pilgrimages are made to a large number of places at which his relics are reputed to rest. The deaths of both the Black Prince and King Henry V. are referred to interference with his relics, the latter dying of fistula, a disease with which the saint was especially associated. He was also concerned especially with the cure of gangrene, ulcers and tumours, and polypus. He is to be regarded as one of the most important of 'medical' saints. In Scotland he becomes St. Musset or Muffet by addition of the honorific "Mo."

THE "GREAT FEAST" OF ISLAM AND MUHARRAM.—The Moslem year begins with the month of Muharram, the holy month, corresponding to our month of August. It is closely connected with the Great Feast which is held in the preceding month. This feast, completing the year, is intended to remove the old evils of the preceding period. Preparations for the sacrifice are made by purification of the people. This is effected by various means, shaving the head, bathing, the use of henna, pilgrimages to shrines, the giving of alms, etc. Then follows the purification of the sacrificial victim, usually a sheep, but failing that, a goat, or even a bullock or small camel. The fact that in Morocco and Moslem North Africa the skin of the victim is often worn by a man suggests that the sacrifice symbolises the death of the old year, the victim being a scapegoat for the people, and the resurrection of the new year in the victim's skin. The next group of customs is concerned with the utilisation of the sacred character of the victim in various ways in divination and magic, and finally come the purificatory rites to remove from the people any spiritual influence pertaining to the sacrifice which might be harmful when they enter upon the new year.

Although all the month of Muharram is holy—any of the numerous magical practices connected with it is held to be efficacious throughout the whole year—the tenth day is particularly sacred and, rather than the first, may be regarded as New Year's Day. It is especially associated with the peculiarly Shī'iah rite of mourning for Hosein and Husain, the sons of Ali, who died on this day. The similar cult of Bâba 'Aišōr in Morocco, a purely mythical being who personifies the old year, affords a reasonable presumption that the mourning for the sons of Ali is an Islamised version of rites connected with the death of the Old Year. At Fez, in a performance given nightly, a cardboard toy house resembles the "Tomb of Al-Husain" of the Shī'iah mysteries.

THE POLA CATTLE FESTIVAL.—The chief cattle festival of the Deccan and other parts of Bombay Presidency is held on the new moon of the month Sāvan or Bhādon (July–September). In the Ahmadnagar District it is held in August, when the Kumbis cover the cowsheds with tinsel paper or vermilion, tie tassels of fibre on the horns of the bullocks and decorate them with flowers, feed them with sugar, bow at their feet, rub them with sandalwood paste, and lay boiled rice before them. In the morning the herd is driven to the temple of the ape-god Hanuman and made to rush round it, the herdsman leading the way. In the Central Provinces an old ox leads the procession, carrying a wooden frame over which torches are fixed. A rope of maize leaves stretches across the way, which the ox has to break with its horns, when all stampede back to the stalls. In Berar, the cattle pass under the Toran or sacred rope dedicated to the ape-god, which is made of twisted grass covered with maize leaves. This rope is a prototype of the Toran, the wreath of maize leaves hung on the door of a bride and touched by the sword of the bridegroom when he comes.

September.

'RIDING THE FRINGES.'—A curious custom is recorded in Dublin, where it was known as 'riding the fringes' (? franchises), and in Cork, where it took place triennially at the beginning of September. In Dublin the Mayor and Corporation rode the bounds inland, and on reaching the sea-shore near Bullough, hurled a dart into the sea. This fixed the limit of maritime jurisdiction. At Cork the Mayor and Corporation put out to sea as far as an imaginary line between Poor Head and Cork Head, supposed to be the maritime boundary of the city. Then the Mayor in his official robes, attended by mace and sword bearer and other officials, went to the prow of the vessel and launched a javelin into the water. Regarded as an assertion of authority, the rite points to the worship of a sea deity—presumably Lir, the Celtic sea god, or possibly his son, Manannan.

THE ASHANTI YAM CEREMONY.—At the beginning of September a festival is held in Ashanti, known erroneously to Europeans as 'the Yam custom,' on account of the Yam harvest. It is a feast in which first fruits indeed appear, but as part of a propitiation of past kings of Ashanti and of the dead—a cleansing of the nation, and a purification of shrines of ancestral spirits, of the gods, and of lesser non-human spirits. Preparations for the feast began on a Monday eleven days before the actual festival. On the following Thursday week all sub-kings, chiefs, and office-holders began to assemble. The king and his retinue, preceded by the Golden Stool, informed the ancestral ghosts, gods, and spirits that the ceremony was about to take place by visiting the houses of all state dignitaries. He poured libations and made sacrifices before their doors, and at the shrines at the cross-roads and elsewhere in order. The festival lasted for several days, with a prescribed ritual for each day. On the afternoon of the Sunday, yams were placed by the king on the great fetish *Odwira Suman* and wine poured over it. In the evening the king went to a certain quarter of Coomassie and threw new yams to the spirits who had answered when called upon. On the Monday, the king, by striking an ox, before it was sacrificed, with the golden state sword, deliberately broke a solemn taboo and defiled a sacred shrine—an evil which was repaired the following day by the sacrifice of a sheep over the golden sword. On the following Friday the country was solemnly purified, beginning with the Golden Stool. But only after new yams had been sent to the shrines of ancestral ghosts, of gods and of non-human spirits, could the king, the chiefs, and the nation partake of the new yams of the harvest.

Societies and Academies.

PARIS.

Academy of Sciences, July 17.—**Charles Moureu, Charles Dufraisse, and Marius Badoche**: Autoxidation and antioxygen action. The catalytic properties of phosphorus compounds. Details of the antioxygen action of various compounds of phosphorus towards benzaldehyde, furfuraldehyde, and styrolene. Phosphoric acid and the phosphate slow down some oxidations in a very marked manner.—**S. Winogradsky**: The agronomic application of a microbiological test. A modification of the azobacter test is described, which indicates the lime and phosphoric acid requirements within 48 hours.—**S. Drzewiecki**: A theoretical interpretation of the experimental ballistic curve $F(v)/v^2$.—**Jean J. Trillat**: A new method of X-ray spectrography. Application to the study of the orientation of the fatty acids by mercury.—**C. Marie and Mlle. M. L. Claudel**: The influence of the pH in the electrolytic deposit of copper in the presence of gelatine. It is known that when copper solutions containing gelatine in solution are electrolysed, the weight of the deposit is greater than that calculated from Faraday's law. This increase depends on the pH of the solution and is at a maximum for pH about 3·2.—**A. Blanc**: The photoelectric current as a function of the field and fatigue.—**A. Morel, P. Preceptis, and A. Galy**: The action of picric acid upon glycyl-glycine. This compound has been obtained in definite crystals, possessing the composition of a monoglycylglycine monopicrate. The crystallographic characters are given.—**J. O. Haas and C. R. Hoffmann**: Tertiary movements in the plain of Northern Alsace.—**G. Nadson and N. Krassilnikov**: Schizophytes of the cæcum of the guinea-pig: Anabæniolum.—**R. Dieuzeide**: The evolutive cycle of *Pemphigella follicularia*.—**R. Sazerac and H. Nakamura**: The mechanism of the preventive action of bismuth against *Spirochæta icterohemorrhagiæ*.

COPENHAGEN.

Royal Danish Academy of Science and Letters, May 11.—**P. K. Prytz**: A manometer based on the optical contact between a microscope and a mercury surface. The triple point of water. In determining the height of a mercury surface, a microscope making optical contact with the surface has many advantages over a pointer; and particularly, it allows of much greater precision. A method by which the vapour pressure of water at the triple point can be measured is given.—**Niels Bjerrum**: Potentiometric determinations of the hydrogen ion activity in mixtures of acids and bases at different salt concentrations and temperatures have been made with the assistance of Miss A. Unmack.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 12).—**A. E. Fersman**: Chemical constitution of the earth and meteorites. A comparison of average analyses of earth and of meteorites shows their extraordinary resemblance (except in the content of magnesium, calcium, sulphur, manganese, and carbon), which suggest the existence of some general laws of cosmic chemistry.—**A. E. Fersman and N. Vlodavec**: Phenomena of kaolinisation in the emerald mines of the Ural. An analysis of a green clay-like mineral showed it to approach the formula

$$(Al,Fe''',Cr)_2O_3 \cdot 3SiO_2 \cdot 4H_2O.$$

This mineral constitutes an indication of the possible presence of emeralds.—**P. P. Lazarev**: A method of determination of the age of a man based on the sensitivity of the eyes. A formula for the determination is given.—**S. Kostychev and S. Soldatenkov**: Pyruvic acid as an intermediate product of alcoholic fermentation. It has always been found possible to isolate pyruvic acid from the products of fermentation of sugar under the influence of yeast when pure cultures of the latter are used.—**M. A. Lavrova**: Ancient dunes of the Onega peninsula. Geological and geographical description of the dunes.—**S. D. Lvov**: The active acidity and buffer properties of grapes and some other fruit. The pH value of the sap of fruit is not accidental, but is correlated with the processes of dissociation of acids of the sap.

VIENNA.

Academy of Sciences, May 18.—**G. Koller and E. Krakauer**: A synthesis of acridine and acridone.—**G. Koller and E. Strang**: A synthesis of acridinic acid.—**H. V. Graber**: Report on geological-petrographical researches in the region of the Hercynian Danube fault.—**L. Waldmann**: Studies on the metamorphosis in the Moldau-Danube primitive rocks of the Waldviertel.—**J. Laimböck**: The influence of radium radiation on the piezo-electric behaviour of a quartz plate.—**E. Göllnitz**: The quaternion functions log x and arctan x.

May 24.—**F. Kautsky**: The biostratigraphic importance of the pectins of the Lower Austrian Miocene.—**E. Gebauer-Fülnegg and F. von Meissner**: The question of the preparation of derivatives of the phenol-monosulphonic chlorides.—**E. Gebauer-Fülnegg**: On aryl-sulpho-phenyl-chlor-amide.—**E. Riess and W. Frankfurter**: On sulphur-containing derivatives of acetophenone.—**B. Karlik and E. Kara-Michailova**: The luminescence excited by α-rays and its connexion with the energy of particles.

Official Publications Received.

BRITISH.

Eighth Annual Report of the Scientific and Industrial Research Council of Alberta, 1927. (Report No. 22.) Pp. 48. (Edmonton, Alba.)

The Journal of the Burma Research Society. Vol. 17, Part 2: Geography of South Tenasserim and the Mergui Archipelago. By H. L. Chhibber. Pp. 127-156. (Rangoon.)

Department of Commercial Intelligence and Statistics, India. Agricultural Statistics of India, 1925–26. Vol. 2: Area, Classification of Area, Area under Irrigation, Area under Crops, Live-Stock, and Land Revenue Assessment in certain Indian States. Pp. v+87. (Calcutta: Government of India Central Publication Branch.) 1.4 rupees; 2*s*. 3*d*.

FOREIGN.

Zemkopibas departamenta rakstu krājums, 7 burtnica. Latvijas jūras zvejniecciba 1927 gadā. (Bulletin statistique des Pêches maritimes de Lettonie, année 1927.) Sakopojis V. Miezis. Pp. 58. (Rigā.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1927.) By William Henry Fox. Pp. 77+8 plates. (Brooklyn, N.Y.)

Diary of Societies.

FRIDAY, SEPTEMBER 7.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

SATURDAY, SEPTEMBER 8.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District Meeting) (at Town Hall, Great Yarmouth), at 11.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District Meeting) (at Town Hall, Morpeth), at 2.

CONGRESSES.

AUGUST 30–SEPTEMBER 2.

SOCIÉTÉ HELVÉTIQUE DES SCIENCES NATURELLES (at Lausanne).—Including following Lectures:—Prof. E. Bosshard: Past and Future of the Wholesale Chemical Industry.—Prof. P. Termier: Recent Impressions of Travel.—Prof. M. Askanazy: Successes and Aims in the Study of Tumours.—Prof. A. Reymond: The Occult Sciences in Antiquity; a Methodological Study.

SEPTEMBER 3–10.

INTERNATIONAL CONGRESS OF MATHEMATICS (at Bologna).—In following sections:—Arithmetic, Algebra, Analysis; Geometry; Mechanics,

Astronomy, Geodesy, Geophysics, Physical-mathematics, Theoretical Physics; Statistics, Mathematical Economics, Calculation of the Probabilities, Science of the Actuary; Engineering and Industrial Applications; Elementary Mathematics, Didactical Questions, Mathematical Logic; Philosophy, History of Mathematics.

SEPTEMBER 4–7.

INSTITUTE OF METALS (Autumn Meeting) (at Liverpool).

Sept. 4.

At 8 P.M.—

(In Arts Theatre, University, Brownlow Hill.) F. G. Martin: Non-Ferrous Metals in the Shipping Industry (Seventh Autumn Lecture).

Sept. 5.

At 10 A.M.—

(At Adelphi Hotel.) General Meeting. A selection of Papers will be presented in abstract and discussed.

Sept. 6.

At 10 A.M.—

(At Adelphi Hotel.) General Meeting. A selection of Papers will be presented in abstract and discussed as time permits.

Sept. 7.

At 9.45 A.M.—

Trip to Bettws-y-Coed and Dolgarrog.

Communications.

The following communications are expected to be submitted:—

Dr. C. J. Smithells, S. V. Williams, and J. E. Avery: Laboratory Experiments on High Temperature Resistance Alloys.

U. R. Evans: Corrosion at Discontinuities in Metallic Protective Coatings.

Dr. A. G. C. Gwyer, H. W. L. Phillips, and L. Mann: The Constitution of the Alloys of Aluminium with Copper, Silicon, and Iron.

W. R. D. Jones: The Copper-Magnesium Alloys. Part III.

G. B. Brook and H. J. Simcox: Note on Practical Pyrometry.

R. May: Eighth Report to the Corrosion Research Committee. The Corrosion of Condenser Tubes. 'Impingement Attack,' its Cause and Some Methods of Prevention.

J. E. Malam: The Rockwell Hardness Test.

T. F. Russell, W. E. Goodrich, W. Cross, and (in part) N. P. Allen: Die-Casting Alloys of Low Melting Point.

F. Hargreaves: Work-Softening of Eutectic Alloys.

R. Genders, Dr. R. C. Reader, and V. T. S. Foster: Die-Casting of Copper-Rich Alloys.

Dr. C. S. Smith: The Alpha Phase Boundary of the Copper-Silicon System.

S. L. Archbutt, J. D. Grogan, and Dr. J. W. Jenkin: Properties and Production of Aluminium Die-Castings.

Dr. W. Hume-Rothery: Methods for Investigating Alloys of Reactive Metals.

C. H. M. Jenkins: The Strength of a Cadmium-Zinc and of a Tin-Lead Alloy Solder.

D. R. Tullis: Note on the Treatment of Aluminium and Aluminium Alloys with Chlorine.

SEPTEMBER 5–12.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Glasgow).

Wednesday, Sept. 5.

At 8.30 P.M.—

Inaugural General Meeting (in St. Andrew's Hall, Charing Cross).—Sir William Bragg: Modern Developments of the Physical Sciences and their Relation to National Problems (Presidential Address).

Thursday, Sept. 6.

At 10 A.M.—

Prof. E. C. C. Baly: Fluorescence, Phosphorescence, and Chemical Reaction (Presidential Address to Section B).

Prof. W. Garstang: Larval Forms: Their Origin and Evolutional History (Presidential Address to Section D).

Joint Discussion on Human Distributions in Scotland.

Prof. Dame Helen Gwynne-Vaughan: Sex and Nutrition in the Fungi (Presidential Address to Section K).

Dr. J. S. Gordon: The Livestock Industry and its Development (Presidential Address to Section M).

At 11 A.M.—

Prof. J. Bronte Gatenby, and others: Discussion on Cell Structures.

At 11.15 A.M.—

Dr. G. C. Simpson, and others: Discussion on the Mechanism of Thunderstorms.

Sir William Ellis, Col. Ivor Curtis, and others: Joint Discussion on School, University, and Practical Training in the Education of the Engineer.

At 12 NOON.—

Prof. J. L. Myres: Ancient Geography in Modern Education (Presidential Address to Section E).

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

Dr. Vaughan Cornish, and others: Discussion on the Preservation of Scenic Beauty in Town and Country.

Friday, Sept. 7.

At 10 A.M.—

Dr. R. A. Sampson, and others: Discussion on the Photographic Measurement of Radiation.

Dr. J. Vargas Eyre, and others: Discussion on Fermentation.

Sir William Ellis: The Influence of Engineering on Civilisation (Presidential Address to Section G).

Dr. H. E. Magee, Prof. E. P. Cathcart, Capt. J. Golding, and Dr. N. C. Wright: Joint Discussion on Lactation and Nutritional Factors allied thereto.

Dr. Cyril Norwood: Education: the Next Steps (Presidential Address to Section L).

At 11 A.M.—

Prof. T. H. Pear: The Nature of Skill (Presidential Address to Section J).

Saturday, Sept. 8.

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. E. A. Westermarck: The Study of Popular Sayings (Frazer Lecture in Social Anthropology).

Sunday, Sept. 9.

At 11 A.M.—

Official Service in the Cathedral Church of St. Mungo. Preacher: Rev. Dr. Lachlan Maclean Watt.

Monday, Sept. 10.

At 10 A.M.—

Prof. A. W. Porter: The Volta Effect: Old and New Evidence (Presidential Address to Section A).

E. B. Bailey: The Palæozoic Mountain Systems of Europe and America (Presidential Address to Section C).

Prof. Allyn Young: Increasing Returns and Economic Progress (Presidential Address to Section F).

Sir George Macdonald: The Archæology of Scotland (Presidential Address to Section H).

At 11 A.M.—

Prof. C. Lovatt Evans: The Relation of Physiology to other Sciences (Presidential Address to Section I).

Prof. F. O. Bower, and others: Discussion on the Size Factor in Plant Morphology.

At 11.15 A.M.—

Dr. H. H. Read, Dr. Gertrude Elles, and others: Discussion on Problems of Highland Geology.

At 11.30 A.M.—

Prof. T. H. Pear, Prof. H. Clay, and C. G. Renold: Joint Discussion on the Nature and Present Position of Skill in Industry.

Tuesday, Sept. 11.

At 10 A.M.—

Dr. C. J. Davisson, and others: Discussion on the Scattering of Electrons by Crystals.

Sir William Pope, and others: Discussion on Recent Advances in Stereo-chemistry

Prof. F. E. Suess, and others: Discussion on the Tectonics of Asia.

J. A. Venn, Dr. J. S. King, and others: Joint Discussion on the Incidence of Taxation in Agriculture.

G. E. Briggs, Dr. F. G. Gregory, and others: Discussion on the Interpretation of Growth Curves.

Aims of, and Developments in, Broadcasting. Papers: (*a*) Sir John Reith: Wireless in the Service of Education. (*b*) Salter Davis: An Experiment in Educational Broadcasting.—Sir Oliver Lodge, W. A. Brockington: Discussion.

At 12 NOON.—

Prof. T. H. Mortensen, Dr. F. A. Bather, and others: Discussion on Bothriocidaris and the Ancestry of Echinoids.

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

At 2.15 P.M.—

Prof. F. E. Fritsch, R. Gurney, and others: Joint Discussion—A Biological Investigation of British Fresh Waters.

Dr. G. S. Carter: The Conditions of Life in a Tropical Swamp: an Investigation of the Swamps of the Paraguayan Chaco (Lantern Lecture).

At 2.30 P.M.—

Prof. E. Taylor-Jones: Spark Ignition (Lecture).

Dr. J. D. Sutherland, and others: Joint Discussion on the Economic Balance of Agriculture and Forestry.

At 2.45 P.M.—

Discussion on the Position of Geography in Scottish Schools.

At 5 P.M.—

Sir John Stirling-Maxwell, Bart.: Forestry in Scotland: Past, Present, and Future (Lecture).

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. F. G. Donnan: The Mystery of Life (Evening Discourse).

Wednesday, Sept. 12.

At 12 NOON.—

(In Bute Hall, University.) Concluding General Meeting.

SEPTEMBER 6 AND 7.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS (Annual General Meeting) (at Masonic Hall, Edinburgh).—Discussion on Paper by A. M. Simpson: Lands Valuation and Income Tax Charges.—Dr. C. Carpenter: William Young Memorial Lecture.—G. Braidwood: Quality.

SEPTEMBER 10–13.

INTERNATIONAL CONFERENCE ON LIGHT (at Lausanne and Leysin).—Among the subjects to be discussed are the Methods of Measuring the Energy and Biological Activity of Light Rays; Irradiated Foods and Sterols; the Climatic and Light Therapy of Various Forms of Tuberculosis.

SEPTEMBER 12–15.

CONGRESS OF THE GERMAN PHARMACOLOGICAL SOCIETY (at Hamburg).

Sept. 13.

Discussions on the Work of the Heart and Vessels in Honour of William Harvey, with papers by Liljestrand, Jarisch, Straub, Anrep, and Mansfeld.

Sept. 14.

Papers by Flury and Zangger on Modern Industrial Intoxications.

Sept. 15.

Paper by Barger on Ergot Bases.

SATURDAY, SEPTEMBER 8, 1928.

CONTENTS.

Ed

Man and Machine.

IN his presidential address to the British Association two years ago, H.R.H. the Prince of Wales gave a comprehensive and illuminating account of the various ways in which the aid of science was being invoked and encouraged to assist in the solution of the industrial and social problems confronting the nation. Not less important are the problems which the advance and application of science are creating in every sphere of national activity. Of fundamental importance is the effect which science is producing in craftsmanship; and it is peculiarly fitting that this should have been made the theme of the address in Glasgow of this year's president, Sir William Bragg, a consummate artist in a craft of his own creation, of which he is the greatest exponent. The address itself is printed in full in our Supplement (p. 353).

Craftsmanship is the quintessence of happy toil. In its highest form it is the greatest contribution which the individual can make to the happiness of the community. It is at once a wonder, a joy, and an inspiration to others. The elements of which fine craftsmanship is compounded are, as defined by Sir William Bragg, knowledge of materials, imagination, technical skill, perseverance, love of the work itself, sympathy with the use that is to be made of it, and with the user. Thus defined, craftsmanship is identical with citizenship at its best, an identity so aptly emphasised in the address: "The craftsmanship of a nation is its very life . . . the state of a nation's craftsmanship is an index of its national health." It should be the high purpose of a community to conserve its craftsmanship by encouraging the progressive modification of traditional crafts and the creation of new ones, and strive by all means at its command for the preservation against the onslaught of mass production, of beauty in its utilities. The contentment of the user is probably less important than the satisfaction of the maker.

There is a tendency on the part of some people to attribute all the ugliness of present-day life to the advance of science and invention, to regard every fresh application of the genius of man with misgiving as adding to the complexity—and perplexity—of existence. The progressive elimination of starvation, famine, pestilence, the satisfaction of the growing needs of rapidly increasing numbers of people, coupled with their increased leisure and ministration to that leisure, the enlargement of man's intellectual horizon, all of which have been made possible by the new crafts called into being

by science, are discounted by these regretful obscurantists. It is well for them to be reminded that science can rediscover for mankind most of the beauties of the past, can enable the skill of bygone craftsmen to be regained and even surpassed, at the same time providing man with new outlets for the exercise of his imagination, instinct for adventure, love of beauty, and technical skill.

We are at present, and have been for a century, passing through a transitional stage, the difficulties of transition heightened by the inability or unwillingness of society to adjust its social, political, and economic institutions, and its outlook generally, to meet without catastrophic shock the successive impacts of science on life. We are still far from achieving understanding of the environment which science has created.

Our outlook on craftsmanship is still essentially conservative. We still incline to regard it in its application to time-honoured occupations, forgetful of the fact that, in most of these, modern methods of production no longer provide scope for the exercise of much creative imagination on the part of the workers engaged in them, that the real craftsman in mass production is the individual who creates the machine, and not the operator, that in few of the old crafts has the individual craftsman survived, or if he has survived, his survival is an anachronism. Sentimental regrets for the passing of the single-handed craftsman in the production of utilities are vain. Modern craftsmanship in industry is the outcome of association, in which many minds and "many hands working in an alliance which is often unconscious, are employed in bringing a product to its finished form." It is true that the machine-made product may not always attain the same perfection as the product of the skilled individual craftsman, but the remedy is to be found in a more perfect machine—mastery over new means of production rather than dependence on the old. As Sir William Bragg says: "Let us try in all possible ways to mend its hardships, but in all honesty let us recognise that we live on modern craftsmanship in its modern form."

To us as a nation of craftsmen there are disadvantages attached to the perfection of the machine. Usually, the more perfect it is, the less intelligence is needed for its operation. The transference of a skilled machine to another country is a simpler matter than the transference of skilled craftsmen, and may lead to the partial transference of an industry to other countries where labour is cheaper, markets just as accessible, and the raw materials of manufacture nearer at hand. The cotton industry is a case in point. Again, the invention of a machine for mass production may result in large numbers of skilled workers being suddenly cut off from their customary means of livelihood, with consequent loss of individual skill. For the first, it is no remedy to reduce the standard of living of the operatives, say, of Lancashire, to that of Indian or Chinese operatives. There should be no room among an educated community for productive processes calling for little intelligence in their working.

The remedy for the first, as for the second, situation is to be found in the full utilisation of the skill of the displaced operatives on new processes, new machines, and in entirely new industries. It is true this postulates a new orientation of outlook in industry for employers and employed, but the nation should profit by it: the old static conceptions of industry and industrial relationships have stood too long in the way of their rationalisation.

The eloquent tribute which Sir William Bragg paid to the qualities characterising our craftsmen, not the least important of which are pride in their work and their adaptability to changing conditions, was well deserved. The obstacle to industrial progress is to be found not among them but in out-worn policy, the incapacity of those who shape it to do more than frame panic measures for the protection of threatened industries, instead of concentrating upon those which, by putting the greatest strain upon our resources of knowledge, ingenuity, and skill, quicken the national intelligence, and thereby enable us to stand pre-eminent by virtue of our capacity to assimilate and apply scientific knowledge, new ideas, new processes, and to devise new machines. "The most active of our modern industries are those which are founded on recent scientific research." The only hope for older industries to gain their former position in the world is for their leaders to encourage and to look to scientific research for salvation and to comply with its precepts, even if this involves the ruthless scrapping of antiquated plant and the adoption of entirely new methods of production.

Not less important than the change from single handed to associative craftsmanship which science has effected, and the consequent changes which this has involved in industrial organisation, is the introduction of a new factor in industry, namely university-trained scientific research workers. The social and political significance of this introduction of scientific workers into industry is apt to be disregarded, so that it is particularly pleasing to

find that Sir William Bragg's address deals with the influence which they can be expected to exert, not merely by bringing scientific knowledge and infusing a scientific spirit into craftsmanship, but also, what is of even greater importance, by bridging that dangerous gulf which has been ever widening between so-called capital and labour. "They can speak with the employer as men also trained in university and college, exchanging thought with ease and accuracy, and at the same time they are fellow-workers with those in the shops, and can bring back there some of the interest and enthusiasm which springs from the understanding of purposes and methods." By bringing the interest and outlook of scientific inquiry into touch with both employer and employed, they may prove to be the flux that will make them run together.

It is not a polite exaggeration to assert that the country should be grateful to Sir William Bragg, not only for choosing for his presidential address a subject which exercises so many minds to-day, but also for the way in which he has raised it above the level of the factious controversy, and for the hope which it inspires. The feat is the more ··markable because he shirks none of the issues ·volved. Fortunately, the attitude of the press ·wards the British Association meeting ensures ·e dissemination of his views among millions of ·r countrymen.

Scientific Calvinism.

·illiam Bateson, F.R.S., Naturalist: his Essays and Addresses; together with a Short Account of his Life. By Beatrice Bateson. Pp. ix + 473 + 4 plates. (Cambridge: At the University Press, 1928.) 21*s*. net.

THE book before us falls into three parts. The memoir is followed by twenty-two essays, ·hich for various reasons are not to be included ·ı Bateson's collected scientific papers. Some of ·hese, such as the lecture to the Royal Horticultural ·ociety, which contains the first English account of ·lendelism, are mainly of interest from the his-·orical point of view, as illustrating the growth of ·he science of genetics, and of Bateson's own ·leas. Others, in particular his Herbert Spencer ·cture on "Biological Fact and the Structure of ·ociety," contain his views on social problems.

The memoir shows us a man who must have ·npressed his contemporaries even had he never ·ıade any serious contributions to knowledge. He ·ormed definite opinions on a number of subjects, from the Sistine Madonna and compulsory Greek to nationalism and natural selection. But the processes by which he arrived at them make it clear that he was one of those radically abnormal phenomena, men who think for themselves. Hence, the life and letters are worth reading, not only by those who knew Bateson himself, or wish to follow the history of genetics, but also by all who desire to study the workings of a certain type of scientific mind. Even in his scientific writings, and still more markedly in his correspondence, Bateson was never afraid of 'thinking aloud.' Some of his ideas have not found any application, some perhaps never will, but others may yet be developed. In particular, no biologist who is interested in the problem of periodic structure, whether it be the segmentation of an arthropod or the striping of a zebra, can afford to neglect his point of view on this subject.

Bateson was of course in advance of his time with regard both to teaching and research. His applications for the chairs of zoology at Oxford and Cambridge (neither successful) contain programmes of study which are to some extent being adopted at the present time. He had the utmost difficulty in obtaining any facilities for research in genetics, and was only able to carry on at a critical period by means of private benefactions. Even NATURE on more than one occasion refused him publication! If we are to measure his success by the impression which he made on his compatriots, Bateson was a failure. In spite of the fact that the British Empire produces more animal and vegetable products than any other state, it boasts of exactly two professors of genetics at the present day, and the geneticists of the U.S.A. and U.S.S.R. are undertaking programmes of research beyond the resources of any British institution, programmes in which Bateson's personal influence can often be traced.

The first two of the addresses show how Bateson came to take up Mendelism. In 1899 he was speaking to the Royal Horticultural Society from his own experience on the effects of crossing various types of plants and poultry. He pointed out the universal occurrence of discontinuous variation as the result of such crossing, and described a case of what is now called dominance. In 1900 he was to read another paper to the same Society on "Problems of Heredity as a Subject for Horticultural Investigation." In the train to London he first read Mendel's paper on inheritance in peas. So completely did it fit in with his own experience and deductions that he incorporated an account of

it into his lecture, which is reproduced in the present volume.

In a number of other papers, including the famous 1914 presidential addresses to the British Association in Australia, and an unpublished lecture on "Gamete and Zygote," we can follow the development of his genetical ideas. But to the reviewer at least, the most interesting essays in the book are those in which he allowed himself to apply his biological ideas to human problems. For he had little sympathy for any but a scientific approach. "Religion, politics and law he mistrusted and disliked; to him they seemed systems of cumbersome intrigue menacing human progress and content." He regarded democracy as based on a fallacy, and socialism as probably impracticable, but he hoped for the coming of a world state and considered the present social order to be both evil and unstable. So very few of us are likely to find support in his writings for our own political views.

The foundation of Bateson's social philosophy was the innate inequality of man. A Scottish soldier, who heard one of his lectures during the War, said, "Sir, what ye're telling us is nothing but Scientific Calvinism," and he had considered the possibility of publishing some of these essays under that title. But he did not, like Calvin and many eugenists to-day, regard a large section of the human race as damnable. He could not sympathise with Galton's condemnation of 'Bohemian' habits ingrained in the nature of certain men. He was inclined to believe that susceptibility to tuberculosis and insanity might be associated with genius, and, therefore, hesitated as to whether such conditions should be discouraged, though he had of course no doubt that the feeble-minded should be segregated. On the whole, he welcomed human diversity in the spirit of the fancier or the dramatist, and he based his social philosophy on its recognition.

When politicians have learnt the elements of biology, which, as Bateson realised, is likely to occur elsewhere before it takes place in Britain, they will attempt to put into practice some of the ideas adumbrated in "Biological Fact and the Structure of Society." They are beginning to realise the evils of an increasing population, and of a criminal law based on the theory that crime calls for punishment rather than treatment. But many of them still hold to the view that equality of opportunity and universal education will lead to equality in other respects, rather than to an intenser social stratification. Bateson's ideal State was stratified, but stratified on grounds of innate differences rather than of ancestry or wealth. Similarly, he deprecated a general code of morals for so polymorphic a species as man, and looked to science for salvation from such codes. "Science knows nothing of sin save by its evil consequence. . . . As science strengthens our hold on nature, more and more will men be able to annul the evil consequences of sin. Little by little the law will lapse into oblivion, and the sins which it created will be sins no more."

In order that the rulers of the country should be at least aware of the scientific view, he was deeply interested in any reforms in the educational system which might achieve that end. He was not very sanguine as to its possibility, and he defended the classics to the last. But he regarded biology and geography as the proper approaches to physics and chemistry, and the reading of ancient authors with a translation as the proper approach to grammar. Hence the present type of scientific teaching current in schools was as little to his liking as that of classics. The reviewer at least can sympathise with his plea that much school laboratory work too often consists of slavishly verifying what has already been verified repeatedly, and that a few lessons in the use of indexes and books of reference would be far more valuable.

Characteristically enough, the book ends with a list of controversies in which Bateson was engaged. His views on most topics were controversial, and for that reason no one can read his essays without being stimulated, for it would, we think, be impossible to find anyone who agreed with him on all points. Nor would he, with his love of human diversity, have expected such agreement. He was often pessimistic of the immediate future, and some of his opinions are perhaps unlikely to stand the test of time, but the premises from which they were deduced are those with which the majority of scientific men would agree, though few could express them so well.

"The one reasonable aim of man is that life shall be made as happy as it can be made, with as much as possible of joy, and as little as possible of pain. There is only one way of attaining that aim: the pursuit of natural knowledge. We are all citizens of one little planet. We are, as it were, a ship's company marooned on an unknown and mysterious island. There is no time to quarrel about our origins. We have food to find and shelter to prepare. Of what that island may provide for our comfort we know still very little. Let us in peace explore the place. It is full of wonderful things, and for aught we know we may yet find the elixir of life."

J. B. S. H.

The Scientific Study of Populations.

(1) *The Human Habitat.* By Ellsworth Huntington. (Library of Modern Sciences.) Pp. xii + 293 + 27 plates. (London: Chapman and Hall, Ltd., 1928.) 15*s.* net.

(2) *The Builders of America.* By Ellsworth Huntington and Leon F. Whitney. Pp. xv + 368 + 4 plates. (London: Chapman and Hall, Ltd., 1928.) 16*s.* net.

(3) *Human Migration and the Future: a Study of the Causes, Effects, and Control of Emigration.* By Prof. J. W. Gregory. Pp. 218 + 4 plates. (London: Seeley, Service and Co., Ltd., 1928.) 12*s.* 6*d.* net.

DR. HUNTINGTON and Prof. Gregory have no little in common. They are both men of science, one a geographer and the other a geologist. They have travelled widely; they are profoundly interested in broad human problems, and are not afraid to go outside the narrow range of technical studies, and upon the basis of their knowledge and experience to discuss social and political questions of the day. In so doing they have sometimes exposed themselves to criticism, but we may be grateful to them, since in general it is more to be desired that men of science should attempt to draw wide lessons from the results of their research than that those without scientific training should do so.

(1) In "The Human Habitat," Dr. Huntington returns to a favourite theme—the influence of climate upon the course of civilisation. He is, as always, interesting and stimulating. He adds little to the scientific foundation, but he works out his views in new and ingenious ways. The cautious reader, while ready to admit that there is no doubt something, and possibly much, in the theory, will probably remark upon the slender amount of evidence at present available in support of the two fundamental notions. These are that all races exhibit maximum activity in a certain climate characterised by frequent variations of temperature and humidity within fairly narrow limits, and that the zone exhibiting this climate has shifted. The latter conception is necessary to explain the fact that the earlier civilisations arose in latitudes where the more progressive peoples no longer dwell.

Dr. Huntington shows some signs of yielding to the temptation to leave the troublesome task of testing these foundations by further research, and to devote himself to the pleasant pastime of speculating about the course of civilisation on the assumption that they are true. This tendency to push speculation beyond limits that are profitable is evident when he brings in biological selection as an adjunct to the theory. He speaks of famines in China, and assumes that the sequence of events is as follows. The inhabitants of the stricken district leave it. Later, the poorest and least efficient return. Not all the competent return, because many of them will have found occupations in towns. Therefore the inhabitants of the district are less well endowed biologically after than before the famine.

There seems to be no evidence whatever that this does in fact happen. It would appear to be quite as reasonable to suppose that the more competent and fearless would tend to return, and that the population would be better rather than worse as a result. What is required is more support for the fundamental conceptions and well-attested evidence as to what does take place, whether in regard to mental and physical activities in different latitudes or in regard to the working of selection in various circumstances.

(2) It would seem that Mr. Whitney had prepared a draft of a popular book on eugenics when he had the good fortune to persuade Dr. Huntington to collaborate, with the result that they produced a work that no one interested in the subject can neglect. The book does not begin in a promising fashion. Certain assumptions commonly made by writers on eugenics which can be severely criticised are uncritically accepted. Later, however, the results of original studies of the American "Who's Who" and of the records of college students are given, which are of no little interest. Unfortunately, the data are not presented in full, and the methods employed in their treatment are not adequately explained. Therefore it is impossible to arrive at any definite opinion as to the importance to attribute to them.

Nevertheless, many of the results which the authors claim to have reached are very suggestive. Thus they state that, among the men who have reached a standing admitting them to "Who's Who," those with the best education leave most descendants, whereas among the women the position is the contrary. The result for men is unexpected. They find a considerably higher fertility among ministers of denominations where a system of family endowment has long been in vogue than among ministers of other denominations. Still more interesting is the evidence that within any group of those following a profession or calling, it is the most valuable who have the largest families.

They believe this to be well substantiated, and to be a favourable aspect of the differential birth-rate. The differential birth-rate may work adversely as between social classes, but favourably within social classes. It is a pity that the evidence for these and other interesting results is not given more fully.

(3) Prof. Gregory has followed up his study of racial problems by a survey of migration. His work is distinguished by scientific detachment, which does not, however, prevent him from seeing the human aspect of the problem. He may be said to have a world outlook. He does not emphasise either emigration or immigration at the expense of the other. It would be possible to debate his views on many of the issues raised. His attitude in regard to the relation between over-population and unemployment in Great Britain might be severely criticised. His estimate of two and a quarter million surplus population seems quite arbitrary. But the value of the book does not lie in its contributions to specific issues. It is valuable because it is a serious attempt to take into account the geographical, biological, and economic considerations which are relevant to a problem which may well prove to be the next test of the world's capacity for statesmanship.

There is no country which is not interested in this matter from one aspect or another. Already the encouragement given by some countries to movement, and the restrictions placed by other countries upon movement, whether inwards or outwards, are potential causes of serious international friction. The future alone can tell whether the nations of the world can rise above narrow and selfish considerations and show some regard for the general welfare. They will only do so if their leaders learn to adopt Prof. Gregory's attitude, whether or not they adopt his conclusions.

A. M. C.-S.

The Milky Way.

A Photographic Atlas of Selected Regions of the Milky Way. By Prof. Edward Emerson Barnard. Edited by Edwin B. Frost and Mary R. Calvert. Part 1: *Photographs and Descriptions.* Pp. vi + 134 + 53 plates. Part 2: *Charts and Tables.* Pp. iv + 52 + 50 tables + 50 charts. (Washington, D.C.: Carnegie Institution, 1927.)

THIS beautiful atlas contains fifty photographs of Milky Way regions taken by Prof. E. E. Barnard with the Bruce telescope of the Yerkes Observatory about twenty years ago. A grant for its publication was made by the Carnegie Institution of Washington so long ago as 1907, and the delay in its appearance is due to Barnard being for some years after that date engaged on the reproduction of his earlier photographs of the Milky Way and of Comets, which form Vol. 11 of the *Publications of the Lick Observatory*; and to the fact that with such a devoted and assiduous observer the making of observations always had prior claim to the publication of results. That such was so is indeed fortunate for astronomy, as there have been very few observers so skilful as he, and what little has been lost owing to lateness in publication is a small price to pay for the continuation of his observational work. Thus the great observer died five years before the publication of this atlas, and it appears ably edited by Prof. Edwin B. Frost and Miss R. Calvert, the latter of whom assisted Prof. Barnard with it during his lifetime. Most of the details of the form of publication had been settled, and the descriptions of the fields written, by Barnard himself.

Many of the regions are the same as those which Barnard had already photographed at the Lick Observatory, and appear in the volume referred to above. A comparison at once shows the superiority both of the Bruce telescope over the Willard lens and of the direct method of reproduction employed in the atlas under review over the collotype in the Lick volume. The Bruce telescope has two photographic lenses of the doublet type of 10 in. and 6¼ in. aperture. It belongs to, and is normally stationed at, the Yerkes Observatory, but forty of the fifty photographs reproduced in the "Atlas" were made during the spring and summer months of 1905, when Barnard transported the telescope to Mount Wilson to take advantage of the clearer atmosphere and lower latitude. It is not stated which lens was employed for the photographs reproduced, but presumably it was in most cases the 10-inch. The definition is excellent over a field of seven or eight degrees in diameter.

Over the ever difficult question of how best to reproduce the delicate detail of celestial photographs, Barnard spent considerable time. He was not satisfied with the uniformity of the collotype process, and finally decided on direct photographic prints from negative copies of the originals, in the hope that with sufficient precautions in the photographic processes the prints would be reasonably permanent. The result is a volume of photographs which for beauty and

faithfulness in the delineation of detail far surpasses anything of its kind that has yet been produced.

The "Atlas" contains photographs of 'selected' regions of the Milky Way, and the great majority of these are naturally clustered round galactic longitude 330°, the portion of the galaxy most rich in interest, in the constellations of Ophiuchus, Scorpius, and Sagittarius. Opposite each photograph is a detailed description of the field; and in the companion volume there is for each field a chart in which are shown the B.D. stars and principal nebulæ, clusters and dark markings, and an accompanying table giving the positions of these objects and other details. It is a little unfortunate that the positions are referred to such an obsolete epoch as 1875. The division, however, into two volumes, enabling photograph, description, chart, and table to be consulted simultaneously, is an immense convenience. It is futile to attempt to describe the photographs: suffice it to say that the dark markings in all their gradation of intensity and intricacy of outline are most faithfully reproduced. The lack of uniformity in the blackness in these photographs of many of the dark markings at once suggests their true cause; that they are obscuring clouds and not holes, as was at first thought. To Barnard we owe most of our knowledge of these markings, and it is therefore appropriate that there should be included in this volume a "Catalogue of 349 Dark Objects in the Sky." The first part of this list was published by Barnard several years ago, and the greater part of the remaining objects were selected by him personally.

There remains to be mentioned the introduction. This appears in the first person as from the pen of Barnard himself, it having been compiled from notes that he put down for this purpose over a period of ten or more years, and from extracts from his published papers. It contains a description of the Bruce telescope, some general remarks on the Milky Way, in particular on its naked-eye aspect, and notes on the preparation of the "Atlas." It ends with a useful bibliography of Barnard's papers on cognate subjects.

Everyone connected with the production of this "Atlas" is to be congratulated. It is a delight to behold and to handle, and forms a fitting memorial to the great observer who planned it. A glance at the striking portrait forming the frontispiece will suggest why anything less noble would have been inadequate.

H. K.-S.

Our Bookshelf.

Evolution and the Spirit of Man: being an Indication of some Paths leading to the Reconquest of the 'Eternal Values' through the Present Knowledge of Nature. By Dr. J. Parton Milum. Pp. 228. (London: The Epworth Press, 1928.) 7*s.* 6*d.* net.

THE subject of this work is "the significance of the evolutionary world view for man himself," and the writer's endeavour is "to re-read the facts of scientific research in the spheres of biology, geology, anthropology, and psychology." The task seems an ambitious one, but it has to be done over and over again unless we are to be submerged by a continually increasing flood of uncorrelated facts. Men of science are often impatient of such attempts, partly because they themselves are interested in particular problems of research, partly because the limitations of their own outlook are apt to be emphasised in these attempts at a synoptic view. Nevertheless, we can imagine a student of any of the natural sciences reading this book with both interest and enthusiasm. It displays not only a remarkable acquaintance with recent research and theory, but also vigorous powers of comprehension, and genuine fertility of speculative resource. The book, in a word, is original and will repay careful study.

It is probable that many readers will find that the anthropological sections interest them most. Dr. Milum regards man as a mutation, and has no belief in any intermediate species such as the brute-man, dear to Freudian psychologists and popular encyclopædists. He is disposed to think that the rigours of the Great Ice Age effected the provocative crisis of the origin of our species. He does not consider that since the Stone Age there has been much in the way of increase of natural intellectual capacity; accumulation of knowledge is not the same thing. He takes the line adopted by the Rivers–Elliot Smith–Perry school, that modern savages are degenerates, not, in the true sense, primitive men; and with regard to civilisation, he regards it as a cultural tradition (not primarily racial) developed by creative individuals, inspired by ideas, and overwhelmed from time to time by barbarians from without or within. There is an especially interesting section upon the relations of the pastoral age of culture to the development of religion, particularly of Christianity. Religious teachers, as well as students of science, would do well to read this excellent book. J. C. H.

The Naron: a Bushman Tribe of the Central Kalahari. By D. F. Bleek. (University of Cape Town: Publications of the School of African Life and Language.) Pp. ix + 67. (Cambridge: At the University Press, 1928.) 6*s.* net.

THE School of African Life and Language of the University of Cape Town is to be congratulated on having attained the dignity of a series of publications, even if, owing to scarcity of funds, it has been possible to attempt nothing elaborate

in form. That, however, is a matter of little moment if the standard of quality continues to be as high as that attained by the first issue. This is a study of the Naron, by Miss D. F. Bleek, the lecturer on Bushman languages in the University.

The Naron are a Bushman tribe of Sandfontein, whose language is closely allied to that of the Nama, and clearly differentiated from those of the tribes whom Miss Bleek calls the Northern and Southern groups, their languages being related but only distantly. The investigation was undertaken at the request of the Government of the South-West Protectorate—an encouraging sign—and the material was gathered on two separate visits. It was fortunate that Miss Bleek was able to pay a second visit, for it was only as her acquaintance with the people grew that they became really confidential—an essential condition of success. It is clear from the analysis of their religious beliefs that nothing but an intimate acquaintance, such as Miss Bleek attained, could avail to disentangle the elements of their religion. They show unmistakable evidence of Hottentot, and possibly of Bantu, influence. Miss Bleek herself thinks that their oldest religion is a worship of the moon. There can be little doubt that this is correct.

A Theory of the Solar System. By Percy John Harwood. Part 1. Pp. iii + 94. 10*s.* Part 2. Pp. ii + 64. 5*s.* (Brighton: The Author, Endersby, Ainsworth Avenue, Ovingdean, 1928.)

THIS work is of the type that in some libraries is politely classified as 'paradoxical science.' Among the author's special contributions to the theory of the solar system is the hypothesis that magnetic fields, of the sun, planets, and comets, play a large part in determining the motions of these heavenly bodies: for example, he concludes that "a magnetic cause rather than gravity underlies precessional movement and change of axial inclination" of the earth (p. 66). Again, "The spheroidal forms of sun and planets may be largely due to the magnetic 'globe' that helps to hold them together. Maybe the oblateness of the forms of Saturn and Jupiter is not due entirely to their rapid rotations, but also to the oblate form of a magnetic field on which their highly vaporized and ionized constituents are hung" (p. 19). Another example of the style may be quoted: "With the idea of the sun as an organic unity in view, so that no strong character in his nature is separate in itself but derives its sustenance from the contributions of service extended to it by other members in its body, as they likewise depend on it, the sun as magnet may for the time being be left, to consider what other agencies are operating in this Great Builder of energetic forms" (p. 21). The work, like most of its class, is the product of earnest and industrious labour on a large mass of undigested scientific reading, on which imagination has been allowed to play, unbridled by any attempt at quantitative estimation. The second volume is of a semi-metaphysical character.

Die Vegetation der Schweiz. Von Prof. Dr. H. Brockmann-Jerosch. Zweite Lieferung. (Pflanzengeographische Kommission der Schweizerischen Naturforschenden Gesellschaft, Beiträge zur geobotanischen Landesaufnahme, Heft 12.) Pp. 161-288. (Bern: Hans Huber, 1927.) 9 Schw. francs.

THIS is the second section of a work to be completed in four parts. It continues the detailed consideration of the environmental factors affecting vegetation in Switzerland. The details concerning rainfall are completed, and a full account is given of snowfall, snow-covering, dew and hoar-frost, hail, and lightning as they influence the structure and development of plant-life. The factor of temperature is introduced, but the account is incomplete in this part. A compound graph illustrates the alterations in the snow-lines at various stations in the Jura and the Alps throughout the year. An instructive and well-printed coloured map indicates the distribution of the chief kinds of vegetation and types of human exploitation of plant-life in the country. A full discussion of the value of this work must be left until it is complete.

Nova Francia: a Description of Acadia, 1606. By Marc Lescarbot. Translated by P. Erondelle, 1609. (The Broadway Travellers, edited by Sir E. Denison Ross and Eileen Power.) Pp. xxxi + 346. (London: George Routledge and Sons, Ltd., 1928.) 12*s.* 6*d.* net.

LESCARBOT'S "Histoire de la Nouvelle France," published in 1609, was based on a year's personal visit and long business relations, for Lescarbot was a lawyer with one of Sieur de Mont's chief lieutenants at Port Royal. An abridged form of the English translation, which did not include the whole work, appeared in "Purchas His Pilgrimes," 1625. The translation was reprinted in 1745 in the Harleian collection, and again two years later. Since then it has not been reissued until the appearance of this volume. The descriptions of the Indians and of early French life in Canada are full and vivid, and give one of the best pictures existing of Acadia in the seventeenth century. The volume is a useful addition to the excellent series of old travel-books in which it appears.

Tidal Research: the Adaptation of Sir Isaac Newton's Tidal Laws to the Prediction of the Height of High Tides; being an Examination of the Cause of the High Tides at Milford Haven, and their Application to the Heights of the related High Tides at Southampton (1st H.W.), Liverpool, London Bridge (Old Swan Pier), and Southampton (2nd H.W.); the patient collection of Physical Facts by which other Facts are Revealed. By Comdr. John A. Rupert-Jones. Pp. 20. (Southampton: The Author, 57 Westwood Road, 1928.) 5*s.*

THE author claims to deduce the height of high water at Milford Haven by considering the *actual* distance of the moon from that port, to which end a table is provided giving this distance. A comparison is made between the calculated and observed heights.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Constitution of Zinc.

THAT zinc was a complex element was demonstrated by Dempster using the method of analysis associated with his name. From the curves published in 1922, he came to the conclusion that the element contained three strong isotopes, 64, 66, 68, in descending order of abundance, and one faint one, 70. A kink in the curves at 67 suggested that this mass number was also probably present. Many attempts were made to check these conclusions by means of the mass-spectrograph, but in no case could the mass lines of zinc be obtained either by the discharge in zinc methyl or by accelerated anode rays.

Following my recent success with germanium, and using the same setting of the discharge tube, I have now obtained satisfactory results from zinc methyl which are in striking agreement with the conclusions of Dempster and disclose two additional components. The mass-spectra indicate that zinc consists of seven isotopes 64 (*a*), 65 (*e*), 66 (*b*), 67 (*d*), 68 (*c*), 69 (*g*), 70 (*f*). The letters in brackets indicate the order of intensity. Three of these mass-numbers, 65, 69, 70, are isobaric with those of copper, gallium, and germanium respectively.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, Aug. 22.

Corpuscular Theory.

G. L. LE SAGE, of Geneva, devoted the best part of his life to a theory of the mechanism of gravity. It appeared in the Transactions of the Berlin Academy in 1782. The fullest account of his theory was published by Pierre Prevost, as editor, in 1818 ("Deux traités de physique méchanique"). The general idea of the theory is that ultramundane corpuscles are flying through space in all directions with great velocity; that they collide with the atoms of mundane matter; and that in consequence they issue from the sun or a planet with less velocity than that with which they entered it. Thus the atoms of the moon are bombarded by corpuscles from all directions equally, except that those coming from the earth have a smaller velocity and, in consequence, the moon is driven towards the earth by the force called gravitation.

This is almost the only mechanical theory that contains the elements essential to a true theory. One other theory of gravitation also fulfilling that condition is founded upon Prof. Frederick Guthrie's experiment on the attraction of a balloon by a vibrating tuning-fork. This experiment was extended by Bjerknes, theoretically and experimentally, to the reactions of vibrating drums in a tank of liquid; and was discussed further by Lorentz.

On Dec. 18, 1871, Lord Kelvin (then Prof. Sir W. Thomson) communicated to the Royal Society of Edinburgh a paper "On the Ultramundane Corpuscles of Le Sage." The theory advanced by Le Sage is there described in great detail. The abstract of this paper occupies about 13 pp. of the *Proceedings* of the Society. The object of the paper was to remove some objections that might be raised to the theory of Le Sage. Lord Kelvin suggested also that the energy of translation lost by corpuscles in collision with atoms might be converted into vibrations, or vibrations and rotations. In this way the excessive rise of temperature in a planet penetrated by corpuscles might be reduced. Clerk Maxwell criticised this. Much later, however, Sir J. J. Thomson expressed the opinion that the kinetic energy might be converted, not into heat but "into the energy of a still more penetrating form of radiation which might escape from the gravitating body without heating it." He added: "It is a very interesting result that the machinery which Le Sage introduced for the purpose of his theory has a very close analogy with things for which now we have direct experimental evidence."

I was present at the reading of Kelvin's paper in 1871. I regret that his abstract gives no account of the nature of corpuscles and atoms which he then described. Atoms were vortex rings, and corpuscles were vortices like a serpent, in which the inside is ejected at its mouth, passes outside, and enters at its tail.

Some years later Aitken exhibited his remarkable experiments on the rigidity of endless chains in rapid motion along the tangent to the curve of the chain (*Phil. Mag.*, 1876 (?)). It then appeared that the vortex filaments in Kelvin's corpuscle would behave in the same way; and that these corpuscles might form the basis of a corpuscular theory of light.

On Aug. 15, 1878, at the Dublin meeting of the British Association, I read a paper on the "Mutual Action of Vortex Atoms and Ultramundane Corpuscles" (*q.v.*), wherein I explained the radiation, propagation and absorption of light. Each corpuscle when passing a vibrating atom would have kinks or saw-teeth impressed on its surface along its whole length. Aitken's results led me to infer that those saw-teeth would remain fixed in position, and would not travel along the vortex-filament. While travelling through space the toothed corpuscle may encounter an atom of the same frequency of vibration as the original radiator. In that case the saw-teeth must set the atom into vibration. Thus is radiation and absorption explained.

That paper may perhaps now, fifty years later, be useful as a suggestion to present-day workers. That paper to the British Association concluded with these words: "The question naturally arises, Can this action be the keystone to a new theory of light? Can the phenomena of reflection, refraction, interference, diffraction, and polarisation be explained by this kind of action? In answer to these questions it can at present only be said that the germs of a complete theory of light do exist in this speculation."

I did not publish anything more on the subject. To-day, however, I will say what was meant by the last sentence. *Plane Polarisation* occurs when the corpuscles have saw-teeth only on opposite sides, and not all round them. Refraction is more difficult to explain. *Interference* and *Diffraction* follow, exactly as in the wave-theory, if corpuscles flying in all directions rob other corpuscles of their saw-teeth and carry them on. The saw-teeth form wave-fronts as in the wave-theory; and these can only be propagated in a direction perpendicular to the wave-front. Diffraction and interference can then be calculated by mathematical formulæ, which are precisely the same as we use in explaining the same phenomena by the wave-theory.

Perhaps these considerations may be of use to-day. My reasons for saying this are that they seem to form a physical basis for quanta, for Einstein's (1905) photoelectric theory, and for the heat of stars, and also for Eddington's law of the mass-luminosity of stars.

Quanta.—The kinks, or saw-teeth, carried off by a corpuscle from a vibrating atom do not penetrate far below the surface of the corpuscle, and the feeblest radiation from an atom more than fills the capacity of the corpuscle. A vast number of corpuscles or quanta are required to carry off all the radiation-energy of an atom.

Source of Stellar Heat.—The best that can be done, by any hypothesis like those suggested by Kelvin and J. J. Thomson, for preventing the superheating of a star by the shock of Le Sage's gravity-corpuscles, leaves a certain residuum of heat due to corpuscular collisions. This may solve the present-day astronomical puzzle as to the source of the sun's heat.

Mass-luminosity Law.—If the heat of stars depend on collisions with ultramundane corpuscles, a star's temperature would be greater for the more massive star, and Eddington's law might follow.

Millikan's Rays might actually have been thought to be these corpuscles when their existence was first demonstrated. The laws that were found to govern them, however, do not seem to favour such an hypothesis.

GEORGE FORBES.

The Shed, Pitlochry.

The Fine Structure of Wool.

EXPERIMENTS were begun some eighteen months ago to determine the fine structure of wool by X-ray analysis with the object of attempting to explain its elastic properties. Some intimation of the earlier results was given at the discussion on the properties of colloids at the Leeds meeting of the British Association in 1927. The experiments have now reached the stage where it seems possible to draw some important conclusions.

The wool chosen in the first instance was a Cotswold wool purified by extraction with alcohol and ether in succession in a Soxhlet apparatus after preliminary soap scouring. The source of X-rays was a modified form of Owen's design with an iron anticathode. By means of a special continuous water-cooling device for both ends, the tube could be kept running continuously all day from a transformer. Since a fibre diagram was to be expected, the 'monochromatic pinhole' method was used, a bundle of fibres being arranged as nearly parallel as possible and at right angles to the pencil of rays.

Precautions were taken to avoid effects due to the rays striking the edges of the last pinhole, and were checked by blank tests. After some 200 milliampere-hours' exposure, the Cotswold wool, unstretched and dry, gave a very definite 'fibre' pattern, which is shown in Fig. 1. The features of this pattern are the two equatorial spots giving a spacing of 10·3 A., the two sharp polar arcs giving a mean spacing of 5·15 A., and the two less-defined equatorial arcs giving a spacing of 4·46 A. (mean). Analysis of this fibre diagram by the method suggested by Polanyi shows that the equatorial spots are caused by planes parallel to the fibre axis, the polar arcs by planes the normals of which lie within a cone of half-angle 17° about the fibre axis, and the equatorial arcs, which are nearly semicircles, by planes orientated almost at random.

Microscopic examination of the cells of wool fibres has shown that the cells consist of a cell-wall, within which are a number of fibrillæ, probably attached to the walls and to each other. Considering these facts with the X-ray fibre diagram, we suppose that the cell-walls are responsible for the equatorial spots, and the fibrillæ for the arcs. If this interpretation is correct, it means that the cell is of elongated spindle shape with its long axis along the fibre and its walls put down in layers of 10·3 A. spacing. The sharpness of the equatorial spots suggests that the wall is many molecules thick.

The longest fibrillæ, on this interpretation, are arranged in a cone of half-angle 17° (with the fibre-axis) connected by the shorter cross fibrillæ. Thus the polar arcs would be produced by the spacing along the fibrillæ, and the equatorial arcs by the side spacing. The sharpness of the polar arcs and the width of the side arcs indicate that the fibrillæ are many molecules long but only a few molecules thick.

There is not the space here to enter fully into the arguments for the preceding interpretation of the fibre diagram. One notable piece of evidence is furnished by photographs of wool stretched 30 per cent of its length. In this photograph the side arcs have sharp arcs superimposed on them, which would correspond to a lining-up of the fibrillæ and a conspiring of the lateral planes. Again, a photograph of the same wool stretched 30 per cent of its length in an atmosphere saturated with water vapour shows a broadening and decrease of definition in both the polar and equatorial arcs. It is known from studies of the stress-strain relationships of wool fibres that, under such conditions, the fibrillæ suffer plastic flow.

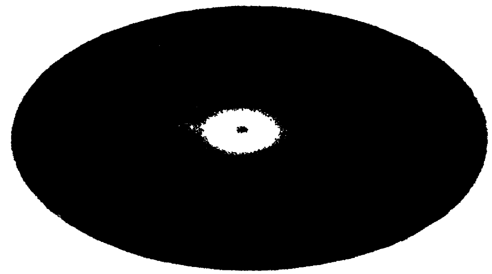

FIG. 1.

One other interesting feature of the photograph of dry unstretched wool is that there is no sign of a 'liquid' ring such as one would expect to be given by a gelatinous cell content—unless one attributes the long and broad equatorial arcs to a gelatinous cell content. In this case, the sharper side arcs produced by stretching would indicate a molecular orientation of this medium, a smectic state caused by stretching.

Carefully purified merino wool has also been photographed in the dry unstretched state and, again, a definite fibre pattern was obtained. This is similar but not identical with that for Cotswold wool. The two polar arcs are more or less isolated on a fainter scattered background. The side arcs cannot be discerned and the equatorial inner spots emerge only as slight thickenings on a heavy continuous circle contiguous with the central spot. Both the similarities and the differences are important. The spacing given by the polar arcs is exactly the same as in the case of Cotswold wool, indicating that the actual material of the fibrillæ is the same in the two cases. Differences in the elastic and other properties of the two wools are probably due to variations in the arrangement and relative amounts of cell-wall and fibrillæ. As regards arrangement in the case of merino wool, the pattern is accounted for by supposing the cell-walls to be thinner and more nearly spherical in shape than with Cotswold wool, the fibrillæ being arranged in a narrow cone along the

fibre axis, and to be so few molecules thick as to give no side arcs. The absence of side arcs in this case is an argument against attributing their presence in the case of Cotswold wool to a gelatinous cell content.

Fuller details of the work and the remaining photographs will be published elsewhere. The examination of other wools is in progress.

J. EWLES.
J. B. SPEAKMAN.

The University,
Leeds.

Condensible Gas Modifications formed under the Influence of Electrodeless Discharges.

WHEN a liquid air trap is maintained in a gas subject to an electrodeless discharge, condensible products are frequently formed, and these are often recondensible over long periods. With hydrogen, oxygen, nitrogen, in well baked-out apparatus such products are formed. They have been variously attributed to atomic modifications, ozone, active nitrogen, and the like. Doubtless such modifications may be formed and be condensed in the liquid air traps, but in cases where repeated recondensations can be effected, such hypotheses cannot be readily adopted. So far as I know, no attempt has been made to find out whether these products are not simply water, carbon dioxide, or oxides of nitrogen. The lack of such an attempt arises apparently from the fact that in a discharge in pure hydrogen there is no obvious source of oxygen, and so on.

I have recently investigated electrodeless discharges in the common gases, using a seven-metre wave oscillator (for method see, *e.g.*, J. and W. Taylor, *Proc. Camb. Phil. Soc.*, **24**, 2, 259; 1928). Standard spectrograms of discharges in hydrogen, oxygen, nitrogen, carbon dioxide, water, and air were taken (pressures 2 mm. downwards), both with (where possible) and without liquid air traps on the apparatus.

The 'clean up' effects were then investigated both with 'cold' electrodeless discharges and with such discharges as those described in a previous letter (NATURE, May 5, 708; 1928), in which electrolytic currents were maintained, by suitable means, across the glass walls of the discharge vessel. In hydrogen, as 'clean up' occurred, a condensible product was formed when a liquid air trap was included in the apparatus. This product was of long life and capable of repeated recondensations. Moreover, its volume was approximately the same as that of the hydrogen that had been 'cleaned up.' In order to examine the product that had been condensed out, the whole apparatus was evacuated whilst the liquid air traps were still functioning. The liquid air was removed after the apparatus had been evacuated and closed, and the spectrogram of the condensible product itself was then obtained.

On again putting on the liquid air, it was found that part of the gas content was now not condensible, but became condensible after continued discharge. Its spectrogram was taken. In all cases the spectrogram of the condensible product was identical with the standard spectrogram for water at low pressure (in both cases the carbon dioxide bands were in evidence), and the spectrogram of the part of the gas that was not recondensible after running the discharge was identical with the non-condensible product formed after running a discharge in water vapour, and further, both of these latter were almost identical with that given by hydrogen. There can remain little doubt, then, but that the condensible product formed from hydrogen is water which partially breaks up to form hydrogen and oxygen under the influence of the discharge when there is no liquid air trap in the apparatus.

With oxygen a condensible product was formed, and this product yielded an exactly similar spectrogram to that obtained from a discharge in carbon dioxide (sometimes there were also weak hydrogen lines in the spectrum, but there was no evidence that any considerable portion of the condensible product was water).

The amounts of gas disappearing in these experiments, especially where electrolytic currents were passed through the glass, were considerable, being as much as 0·7 c.c. of gas at N.T.P. in certain cases, consequently, it is at once obvious that any products formed in minute quantity are not detectable.

The question arises as to the origin of the water and carbon dioxide. In a previous letter (loc. cit.) I have described results on the disappearance of gas under the action of an electric current passing through the glass walls of the containing vessel, and shown that laws similar to Faraday's Laws of Electrolysis are valid. Further work has confirmed the result that the quantity of gas disappearing is directly proportional to the electrical quantity that has traversed the walls. The number of atoms disappearing per electronic charge is, however, variable according to conditions. For example, at the beginning of a run with hydrogen, H_2 disappeared for every electronic charge transferred in many cases, but with continued running, H disappeared for every electronic charge transferred.

The results show that glass must be regarded as an electrolyte and the gas disappearance under the action of the discharge is consequently due to the chemical interaction of the gaseous ions with the electrolytic products and ions of the glass. In the simplest picture glass is to be regarded as a solution containing Na_2SiO_3 as electrolyte. For every two electronic charges transferred across the glass 2Na is liberated at the cathode. The SiO_3 radical at the anode breaks down into SiO_2 and O, which unites in the case of hydrogen discharges with one hydrogen molecule to form one molecule of water.

This simple picture may represent some of the facts, but it does not explain, for example, why under certain conditions H_2 disappears for every electronic charge, and why oxygen disappears even more readily than hydrogen. We must consider then that glass is a complex electrolytic solution probably containing peroxides (until they are reduced by continued discharge with hydrogen), and certainly containing compounds of carbon which produce chemical reactions with the gas ions impinging against the glass surface.

It must also be borne in mind that condensible products are formed when a liquid air trap is on the apparatus, but gas 'clean up' occurs also when there is no liquid air trap, when the products must be retained in the glass structure or absorbed in the walls.

JAMES TAYLOR.

Newcastle-upon-Tyne,
Aug. 6.

New Type of Interference Fringes.

IF a pair of optically flat plates, making a wedge angle of a few seconds, be placed in the beam from a collimator with a cross slit (to obtain effectively a point source) and the eye be placed at the focal plane of the telescope objective (without eyepiece), straight fringes are seen which are localised at the plates. Essentially they are the fringes observed by Fizeau, who used a back reflection method.

When the plates are half-silvered, the comparatively broad and feeble transmission fringes now become very narrow and clear, the multiple reflection in the silver films producing the same sharpening

effect here as it does on the Haidinger fringes in the Fabry–Perot interferometer. This is somewhat surprising. With Fabry–Perot rings the plates have to be exactly parallel, so that the wave-fronts from successive reflections remain parallel; in this instance the successive wave-fronts are rotated by an amount equal to twice the wedge angle. The latter, however, is so small that even thirty or more such deviations are in aggregate less than the smallest angle resolvable by the eye.

With silver films of about 40 $\mu\mu$ thickness, and a spacing of about 1 mm. between the plates (so that any lack of homogeneity of the source should not enter) a bright fringe, using a monochromatic red source, seems to occupy less than a twentieth of the distance between consecutive fringes, the fraction increasing to about an eighth in the violet.

These fringes can be used to test the parallelism of a plate (*e.g.* Lummer–Gehrcke) or of the Fabry–Perot mirrors themselves, to a far higher degree of accuracy than is possible with the usual Fizeau fringes. Considering the latter example, as the adjustment for parallelism proceeds, the bands spread out. If it can be arranged that one bright band should cover the whole field of view, it means that with a monochromatic red source, a lack of parallelism or a local defect amounting to about $\pm \lambda/40$ in path difference will cause the field at point to change from red to black. This is very much more sensitive than with the Fizeau fringes, which require $\pm \lambda/2$ path difference to change from bright to dark.

One precaution must, however, be taken; when the plates are parallel, the effective separation must be such that it is a bright band that covers the field, and not the semi-dark background in between the bands, for if the separation is such that we are half-way between two fringes, an error of very nearly $\pm \lambda/2$ *could not even be detected.* By rotating the mirrors (as a whole) a small amount so that their normal is no longer coincident with the axis of the collimator, the requisite condition is readily obtained.

The same fringes can be used, for example, in place of Newton's rings whenever a small displacement or a small change of refractive index is to be measured, the gain in accuracy being between five and ten times.

W. EWART WILLIAMS.

Wheatstone Laboratory,
King's College, London, W.C.2,
Aug. 10.

Some Experiments on Water-Divining.

THE following affords a brief account of some experiments on water-divining carried out near Fyvie Castle, Aberdeenshire, on April 28, 1928, and indicates some inferences which may be drawn therefrom. The dowser was Mr. G. L. Cruickshank, of the Fyvie Castle Estates.

Tests were first made in places where running water was known to be. The dowser made use of a short forked twig, and when he stood over the water course the twig was forced up. If a piece of thick glass were placed under his feet the sensation ceased and the twig dropped. The same effect was got when the twig was held by two pairs of steel pliers, or if the ends held by the hands were first covered with rubber tubing. Likewise, no sensation was perceived if only one end was held by pliers or covered with rubber tubing, the other being held in the usual way by the bare hand.

Another set of observations was carried out with the dowser blindfolded. He was made to cross a line which he had previously marked out as being a water course. Nobody approached within several yards of him. When he passed over the line previously indicated, the exact position of which he had no idea, the twig moved upwards. As he passed beyond the line, the twig immediately fell.

In these experiments the external manifestation is a forcing upwards of the twig. This raising of the twig must be due to some muscular action on the part of the dowser. This would indicate that he is the mover, though in his own mind he is apt to consider that he is working against some external force. If then his muscles force up the twig, the nerve centres controlling these muscles must have been influenced in some way by an outside stimulus. May it be, therefore, that some kind of influence is radiated from water running under pressure, and that a 'receiving set' tuned to respond to such a stimulus is possessed by certain individuals? A definite arrangement of the body seems to be necessary for proper reception of such a stimulus, and certain substances appear to be able to prevent the arrival of the stimulus. As different individuals may respond in different ways to such stimuli, care must be exercised in drawing general conclusions from observations made on any particular individual.

It seems reasonable to conclude, however, (1) that the faculty of water-divining is possessed by some individuals; (2) that the individual responds to some, at present unknown, external stimuli; and (3) that certain substances can prevent the arrival of those stimuli, in which case the individual cannot respond.

A. E. M. GEDDES.

12 Louisville Avenue,
Aberdeen.

The Palæolithic Implements of Sligo, Ireland.

1. FROM an examination recently made by me of the Sligo shelter-site, I consider that the coast at, and for some distance east of, the beacon on Coney Island (that part illustrated by Messrs. Boswell and Jones in NATURE of June 2) is undergoing erosion under present conditions, but that at Rosses Point it is possible, though only just possible, that the remains of a rock-shelter could have survived since Palæolithic times, the odds against survival being of the order of at least 100 to 1.

2. The burden of the proof of age of specimens found at Rosses Point must depend, therefore, on internal evidence, and that evidence must be conclusive.

3. The specimens found by Mr. Burchell at Rosses Point and *in situ* in Boulder Clay in the neighbourhood are, as a suite, unlike the flakes produced by any natural forces with which I am familiar, but, on the other hand, carry such impress of design as compels me to regard them as of human origin.

4. The forms of those from Rosses Point are not those of quarryman's refuse, and the site is a most unlikely one for a quarry. On the contrary, they appear to belong to a crude Stone Age industry.

5. Their preservation, unrolled and with comparatively unblunted edges, despite the fact that the site has been within reach of wave-action since glacial times, would appear to be sufficiently explicable from the fact that they were recovered from beneath massive blocks of limestone.

6. The occurrence of similar flakes in glacial deposits in the neighbourhood *in situ* confirms, in my opinion, the provisional inference (par. 4) as to the age of the Rosses Point specimens. It would appear that the 100 to 1 chance has succeeded.

ERNEST DIXON.

H.M. Geological Survey,
28 Jermyn Street, S.W.1,
Aug. 14.

Reproduction of Scales by Electric Discharge to a Photographic Plate.

It is a known effect that when a coin is placed on the film side of a photographic plate which rests on a sheet of tin-foil, and the coin and tin-foil are connected to the secondary of an induction coil, an image of the details of the coin is obtained on developing the plate after discharge. The effect appears to be due to the light of a brush discharge from the coin, the intensity of which depends in a somewhat complex way on the contour of the coin, and the distance of its parts from the plate.

I have found this method suitable for the accurate reproduction on glass of metal scales, for there is no uncertainty, as with a camera, about the magnification. The steel rule, carefully washed with benzene or alcohol to remove grease, was laid on the film, an even pressure being applied along the rule by weighting it. After these operations, which were performed in a red light, a discharge was passed between the rule and tin-foil, and the plate developed. In this way the scales were sharply reproduced—even the 1/100th inch divisions—as seen under a microscope (Fig. 1).

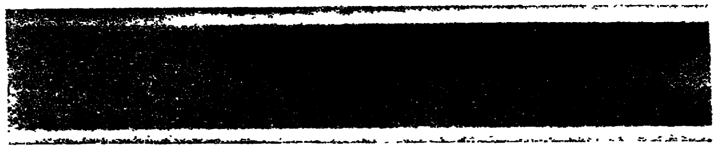

FIG. 1.

A trial with a half-tone copper block, such as is used for magazines, showed that much fineness of detail is attainable with the method, for a good reproduction was obtained in spite of the minute depth of etching. The method was also found applicable for the examination of the structure of coke, the specimen being ground to a plane face for the purpose.

J. H. CHESTERS.

Physics Laboratory, University of Sheffield.

Excavations at Gough's Caves, Cheddar.

DURING the past winter months, the authorities now in charge of the caves, usually known as Gough's Caves, at Cheddar decided to widen the entrance way in order to cope with the increased tourist traffic. It will be recalled that discoveries of flint implements and the bones of living and extinct animals were made in the course of the excavations necessary to open up the cave to the public, and further, that in the early years of the present century, portions—the remainder is still *in situ*—of a human skeleton of upper palæolithic date were found.

Therefore, in view of these important discoveries, those now responsible for the cave determined to carry out the work of path widening in a scientific manner. Mr. R. F. Parry personally superintended the work and kept very careful records. Under his direction the floor material of limestone blocks, gravels, and red cave earth was removed in six inch layers, sorted, and the remains given their layer number.

This detailed labour was well rewarded by the discovery of more than one thousand flint implements and flakes, many of these being carefully worked and of typical late palæolithic form. In addition to these a fine *bâton de commandement* decorated with incised lines, some small bone points, and a number of teeth perforated for suspension, were found. This is only the second *bâton* to be found in England, the former incomplete one also coming from this cave.

Numerous remains of animals were found, and parts of two human skulls, one of a child and one of an adult. These, according to Sir Arthur Keith, compare very well with the skull of the original skeleton and with those from Aveline's Hole, Burrington Combe. The latter are also of late palæolithic date.

E. K. TRATMAN.

Spelæological Society, University of Bristol.

Can the Hand be thrust in Molten Lead without Injury?

AT p. 201 of "The Memoirs and Correspondence of Lyon Playfair," by Wemyss Reid (1899), an account is given of the Prince of Wales (afterwards King Edward VII.) having put his hand into boiling lead. This account appears to have been copied by Sir Sidney Lee at p. 73 of volume 1 of his "King Edward VII." I have often heard it stated that a finger or hand can be put into molten lead, and have had many opportunities of putting the matter to a practical test—but have not taken them! Hence I am writing to inquire whether this feat may be safely done, and if so, what is the explanation.

A. S. E. ACKERMANN.

Wave-length Shifts in Scattered Light.

(*By Cable, through Science Service, Washington, D.C.*)

PROF. RAMAN'S brilliant and surprising discovery that transparent substances illuminated by very intense monochromatic light scatter radiations of modified wave-length, and that frequency difference between emitted radiation and one exciting medium is identical with frequency of infra-red absorption bands, opens up wholly new field in study of molecular structure. I have verified his discovery in every particular, using improved apparatus which makes it possible to photograph strongest lines in few minutes. Anti-Stokes' terms of intensity nearly equal that of lines of wave-length greater than exciting line obtained chloroform, carbon tetrachloride, latter giving triplet each side 4046, 4358, 5461 lines mercury arc. Raman reported no trace modified lines excited latter line, but are strong with carbon tetrachloride. Triplets short wave-length sides exciting lines appear mirror images those long wave-length side, considering exciting line mirror. Crystalline quartz gives strong line identified as $20\,\mu$ absorption band, and fainter line very close exciting line corresponds infra-red absorption about $75\,\mu$. Raman's discovery thus makes possible investigation remote infra-red regions hitherto little explored owing experimental difficulties. As yet I have found no line corresponding more generally known band quartz (eight and half μ). This expected as small energy exchanges between impinging light quanta and molecules more probable than large; these correspond absorption bands very long wave-length.

Many lines discovered Raman found double account very efficient method of illumination employed; considerable resolving power possible. Now preparing for spectrum photograph forty foot focus prism spectrograph. Certain lines are distinctly banded: structure, sharp intense red side, shaded off on violet; strength anti-Stokes' terms in case carbon tetrachloride in marked contrast with their faintness in case benzene and toluene, no trace appearing except after long exposures.

It appears to me that this very beautiful discovery, which resulted from Raman's long and patient study of phenomena of light scattering, is one of most convincing proofs quantum theory of light which we have at present time.

R. W. WOOD.

Loomis Laboratory, Tuxedo, New York.

Down House as a Darwin Memorial.

MR. GEORGE BUCKSTON BROWNE, fellow of the Royal College of Surgeons of England and of the Society of Antiquaries, London, having acquired Darwin's home, Down[1] House, in the County of Kent, from Prof. C. G. Darwin, grandson of the naturalist, has transferred its possession to the British Association under the most liberal conditions, and with an endowment amply sufficient for its maintenance and preservation for all time. The Association have now issued a full description of the house, and from it the subjoined particulars have been extracted.

At present Down House serves as a private school. When the tenant's lease falls in or is acquired, Mr. Buckston Browne desires that the property be regarded as a gift to the nation and opened to visitors every day of the week between the hours of 10 and 6, without charge. He also desires that the Association should use Down House and grounds for the benefit of science. The donor has also suggested that certain of the rooms—particularly the old 'study,' in which the "Origin of Species" was written, should be furnished, as near as may be possible, as they were when Darwin lived in them. He has already taken steps to secure this end, and has obtained the willing co-operation and greatest assistance from various members of the Darwin family. Indeed, without the generous co-operation of the Darwin family the transfer of ownership could not have been effected. The late Mrs. Litchfield, the third daughter of Charles Darwin, bequeathed for Down House her father's study chair and letter-weighing machine. Mr. Buckston Browne has commissioned the Hon. John Collier to paint replicas of his well-known portraits of Darwin and of Huxley to be hung at Down House, commissions already completed.

It is hoped that the shelves of the old study may be filled with all editions of Darwin's works; and that Down House may become a Darwiniana where students will have an opportunity of consulting all original documents concerning Darwin and his writings. Such an end can be attained only if the British Association succeeds in enlisting the sympathetic co-operation of all who may be the fortunate owners of articles which were in the possession of Darwin or were associated with his life.

It may not be amiss to recount some of the circumstances which led up to the appeal for the preservation of Darwin's home. Some years before his death, the late Sir Arthur Shipley, Master of Christ's College, Cambridge, where Darwin was an undergraduate, wrote to a member of the British Association as follows: "It seems to me that Down House ought to be a national possession. Do you know of any means by which this can be brought about?" On the eve of the Leeds meeting of the British Association, on Aug. 31 of last year, the Council of the Association considered this matter and empowered the then president (Sir Arthur Keith) to make a public appeal at the close of his presidential address, with the happy result which all now know. It was with as much surprise as satisfaction that Sir Arthur Keith learned that the man who answered the call was a fellow of his own College. Indeed, he knew Mr. Buckston Browne as a generous benefactor to that College and to the Harveian Society, but was unaware of his love for Darwin and for Down. It was later that he learned that Darwin's friend Huxley had long ago exerted an abiding influence on the donor of Down.

Darwin was born at Shrewsbury on Feb. 12, 1809; Down House was purchased for him by his father, Dr. Darwin, and he took up his residence there on Sept. 14, 1842. Darwin was then in his thirty-fourth year; three years previously he had married his cousin, Emma Wedgwood. His two eldest children, William and Anne, were born in London; the third, Mary, was born and died just after arrival at Down. Then followed in 1843 Henrietta, who became Mrs. Litchfield; in 1845, George, who became Sir George Darwin, and whose son, Prof. C. G. Darwin, succeeded to the ownership of Down and is the fifth of a succession of father and son who have been elected fellows of the Royal Society—a unique record; in 1847 Elizabeth was born; in the following year Francis, who became Sir Francis Darwin—a distinguished botanist and president of the British Association. Leonard followed in 1850—Major Leonard Darwin, scientific worker, philanthropist, and the founder and still active supporter of the Eugenics Society. Then came Horace, now Sir Horace Darwin, happily, still alive; and last, number 10, Charles Waring Darwin, who died in childhood. Down was the home of a large and happy family, perhaps the most gifted family ever born in England. There the great naturalist died on April 19, 1882.

In that period Darwin made his first draft of the "Origin of Species" (1842); he wrote his researches on the zoology of the *Beagle*, on "Structure and Distribution of Coral Reefs," and prepared a new edition of his "Journal of a Naturalist." Before he settled down to work at barnacles, to which he gave seven years (1847–54), he prepared his papers on volcanic islands and on the geology of South America. Preparations for the "Origin of Species," which did not receive its final form until 1858–59, went on continuously from 1842 onwards. Then followed his inquiries into "Fertilisations of Orchids" (1862), "Variations of Animals and Plants under Domestication" (1868), "Descent of Man" (1871), "Expression of the Emotions" (1872), "Movements and Habits of Climbing Plants" (1876); "Insectivorous Plants" appeared in the same year; "Cross- and Self-Fertilisation" in 1876, and his last work of all, one which was begun soon after he settled at Down, "The Formation of Vegetable Mould through the Action of Worms."

No single home in the world can show such a record. Truly, from Down, Charles Darwin shook the world and gave human thought an impress which will endure for all time.

[1] On the Ordnance Survey maps the spelling is *Downe*, but as Darwin always wrote *Down* without an 'e,' the latter spelling has been adopted.

Some Recent Work on the Light of the Night Sky.[1]

By LORD RAYLEIGH, F.R.S.

PERIODICITIES.

AN annual periodicity was early suspected in my own observations in England. At the time of writing, observations lasting over five years are available, so far as the auroral component is concerned. To examine impartially whether or not an annual variation is present, the observations

	August.		October.	November.	December.	January	February.	March.	April.
1922-3	..						−0·5	0·0	−1·9
1923-4	+0·0	+0·3	+0·7	+0·0	−2·2	−2·2	−1·6	−0·3	−1·7
1924-5	+1·0	+0·7	+1·6	−0·9	−0·8	−1·5	−1·2	−0·8	−1·8
1925-6	+0·8	+0·9	+0·8	+1·5	+0·0	+0·5	−0·3	−0·4	+0·0
1926-7	+0·5	+0·8	+1·3	+1·1	−0·4	−0·7	+0·0	+0·8	−0·5
1927-8	+2·0	+1·2	+1·8	+0·9	+1·0	−0·3		..	..
Sum .	+4·3	+3·9	+6·2	+2·6	−2·4	−4·2	−3·6	−0·7	−5·9
Mean	+0·9	+0·8	+1·2	+0·5	−0·5	−0·8	−0·[illegible]	−0·1	−1·2

of each calendar month (say, November 1926) are averaged, and the mean is adopted as representative of that particular month, without further reference to the data for individual nights.

The individual seasons and the mean are plotted in Fig. 2.

Although the results are not numerous enough to give complete statistical regularity, yet I think it is difficult to resist the indications of a definite annual period. The great fall of intensity usually occurs between November and December. In each of the four complete observing seasons (August to April) the mean of all months before this date is much greater than the mean after it. This fall must have its counterpart in a recovery, which would naturally be taken to occur six months later, that is, between May and June.

No observations can be made at that season owing to residual daylight. But in every one of the five cases available, a considerable recovery has occurred at some time between April and August, in the interval when residual daylight prevents observations.

Special attention is directed to the mean curve at the bottom of Fig. 2, which sums up the evidence for annual periodicity. The amplitude of annual variation indicated is about 2 units, or a factor of 1·6. The subordinate maximum in March may be due to coincidence of irregular variations, but it is well to keep an open mind on this point, particularly in view of certain magnetic periodicities.

Turning now to a second question, that of variation in the cycle of the sunspots, it is to be noted that the observations begin at about the time of sunspot minimum in 1923, and that according to present expectation the maximum will be reached in the present year, 1928. By analogy with other phenomena known to depend on the sunspot cycle, we should anticipate an increase in the light of the night sky during this period, if such an influence exists at all.

To eliminate any effect of the annual periodicity just discussed, it is necessary to compare the intensity in successive years at the same season. If we look at any given column in the table (say, October) we find a tendency to increase with time, though this tendency is not strong enough always to assert itself against the irregularities after the lapse of a single year. But in every one of the nine columns the last entry is substantially higher than the first. If the variations when cleared of the annual periodicity were quite unsystematic, the chance of this occurring would be only 2^{-9}, or 1 in 512.

For greater statistical regularity, we may take the mean of all the months in a given observing season, or in a given year. To include observations taken in the spring of 1923 and in the present uncompleted observing season, the latter course is adopted.

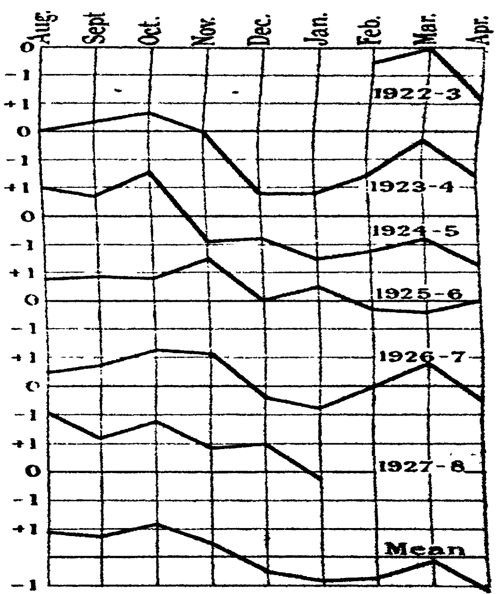

FIG. 2.

The result is shown graphically in Fig. 3. The mean annual increase is 0·3 unit, representing a factor of 1·07. Thus the results clearly indicate a general yearly increase of the intensity during practically the whole period of observation, relative to the uranium standard. This could be explained away if we assumed a slow loss of brightness in the standard, but there are reasons which seem adequate for rejecting this explanation.

Returning to the question of annual periodicity, it seems probable that this depends on the sun's motion in declination. If so, the effect should be negligible at the equator, and should show itself in the opposite

[1] Continued from p. 317.

phase in the southern hemisphere. There is some evidence from the available data that this is in fact the case.

POLAR AURORA.

It is important to distinguish between the polar aurora occurring typically in the auroral zones, and the non-polar aurora occurring all over the earth. Both have the green line $\lambda 5578$, which has been shown by the work of McLennan and his colleagues to be due to oxygen, as the strongest feature of the visual spectrum. It may seem an arbitrary procedure to distinguish two separate phenomena when there is so much in common, and I know from correspondence and otherwise that some scientific men are unwilling to admit it. Nevertheless, after further experience and study, I am more than ever convinced that it is necessary.

The grounds on which this distinction was originally made were that the nitrogen bands (negative bands) occur only in the polar aurora; that the polar aurora has a distinctive distribution in latitude which the other has not; that the polar aurora often shows distinctive forms such as arcs and draperies, whereas the non-polar aurora is uniform; while, finally, the polar aurora varies enormously in intensity in the course of a few minutes, whereas the non-polar aurora is often sensibly constant for days. I wish now to discuss the subject from the viewpoint of intensity measurements.

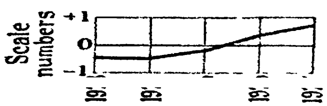

FIG. 3.

We find, in the majority of stations, where 'auroral displays' rarely, if ever, occur, that the range of intensity observed through the auroral filter, which I take as a measure of the intensity of the green line, has a fairly definite mean value of about 0·4 on my scale, with a standard deviation of 1·0. It is true that this intensity is subject to a yearly, and probably also to an 11-yearly, variation. But these variations are comparatively slight, and for the present purpose may be ignored. Lerwick (Shetland), Victoria (British Columbia), and Kingston (Ontario) are stations where auroral displays are comparatively common. At the Cape, or at Canberra, or Hawaii, they are practically unknown. The case of England is intermediate. Auroral displays occur occasionally, though not often.

Let us consider what happens in this intermediate case, where the statistical issue can be most easily presented. In the year 1926 my observations in England on 75 nights, in the absence of an auroral display, give for the auroral intensity:

Range . .	$-2{\cdot}2$ to $+3{\cdot}0$
Mean value .	$+0{\cdot}2$
Standard deviation	$1{\cdot}1$

Now only one auroral display was observed, when it was found that

Auroral display gave .	$+16{\cdot}0$
Deviation from the mean	$+15{\cdot}8$

thus giving an isolated deviation of no less than 14·4 times the standard. As is well known in all ordinary cases of statistical distribution, values three times the standard are nearly the highest that occur. A value 14·4 times the standard is fantastic, and shows that we are attempting to classify in the same scheme values that are not properly comparable at all. In the case of barometric variations at sea-level, such a deviation would mean a barometric height of about 34·7 in.! This comparison shows that we must class auroral displays as quite a distinct set of phenomena.

As is well known, the visual light of an auroral display consists for the most part of the visual green line, and accordingly it is this component (auroral green) which is most strongly reinforced when a bright display is in progress. It is always found, however, that the red and blue components are strengthened as well. The following typical examples may be given:

Place.	Date.	Red.	Auroral.	Blue.
Victoria . .	Sept. 20, 1925	+2·6	+13·5	+13·0
Kingston . .	Mar. 5, 1926	+5·9	+13·0	+13·4
Lerwick . .	Jan. 13, 1926	+2·1	+16·7	+11·9

These may be compared with the normal values in the absence of a display, given earlier in this paper. The increase of intensity in the blue part of the spectrum is probably attributable in the main to the negative bands of nitrogen. The increase in the red is less marked. It may be due in part to the known red line of the aurora, but I believe more to an (apparently) continuous background, which may, of course, be an unresolved band spectrum.

CONCLUSION.

In conclusion, I must emphasise that much of the work of this paper, though necessarily organised and edited from one centre, would have been impossible without the friendly and generous cooperation of the workers whose names have already been recited. They have given their time and trouble without stint.

As regards the future, it has been borne in upon me that greater accuracy of photometric measurement is a chief requisite. This will be obtained by means of a photoelectric cell. Most of the difficulties have been overcome, and preliminary observations have been in progress for some months past. I have been able to follow the changes of intensity from hour to hour on clear nights; some evidence has been found suggesting a diurnal periodicity. The observed intensity nearly always increases between nightfall and midnight, beyond which the observations have not usually been carried.[2] Although no correlation has been found

[2] On June 28, Prof. J. C. McLennan arrived at a similar conclusion as to the course of change during the night in his Bakerian Lecture delivered before the Royal Society. I merely add this note to make it clear that Prof. McLennan's conclusion and my own were reached and recorded quite independently, this paper having been communicated to Prof. Chapman for publication on June 18.

(*Continued on p.* 373.)

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Craftsmanship and Science.

By Prof. Sir WILLIAM BRAGG, K.B.E., D.Sc., D.C.L., LL.D., F.R.S.,
President of the British Association.

INAUGURAL ADDRESS DELIVERED AT GLASGOW ON SEPT. 5.

WHEN, nearly a century ago, the founders of our Association drew up a statement of purposes and rules, they gave prominence to the words "to obtain more general attention for the objects of Science." Since that time we have tried continuously to fulfil our self-imposed task, not, I hope, unwisely, not untactfully, nor without success. For this purpose we have on many occasions and in many ways endeavoured to describe the progress of our researches, and to present the consequences of discoveries as they appeared to the discoverers. With your permission I would like this evening to add something to the story. I would claim as my justification for doing so the fact that in the last few years scientific inquiry has advanced at a rate which to all is amazing, and to some is even alarming. On one hand, the application of science to industry has become increasingly important and obvious, as was so clearly shown by our honoured president of two years ago. Especially at the present time, when our country is struggling to free itself from distress due partly to the War and partly to violent changes in economic conditions, is it of interest and importance to consider what science is doing and can do to accelerate recovery. On the other hand, in the less material realms the applications of recent research have aroused wide interest, as may be exemplified by the influence on philosophic thought of the new discoveries in physical science, or by the effect of last year's remarkable address from this chair.

I cannot deal in the time allotted to me with all the issues that are suggested by these considerations. I propose to limit myself in a manner which my choice of title will suggest, and in speaking of 'craftsmanship and science,' to pay attention more particularly to the relations between science and the craftsmanship of our own country. I shall not, however, be able to confine myself strictly within these limits, because the entrance of science into our most material businesses cannot be considered without reference to the part that science plays in the whole range of our thoughts and actions.

SKILL AND PRODUCTION.

The term craftsmanship requires definition. I am supposing it to mean the skill which is exercised in the production of whatever is wanted for human welfare. Imagine an island so cut off from the rest of the world that its inhabitants must depend on themselves for the satisfaction of all their desires, for their food, even if they have no more to do than pick fruit from a tree, for their clothing, for their housing, and other material things. They must also find their own means of satisfying less material cravings: for if they have intelligence they will look for means of studying themselves, their neighbours and the world round about them. Their eyes and ears will ask to be used for the satisfaction of a sense of beauty in form and colour and sound, and their minds will try to reach out beyond what can be seen and heard. It is impossible to proceed to the satisfaction of these desires without the handling of materials, and craftsmanship begins with the skill exercised in the handling.

What the islanders succeed in achieving by their craftsmanship may justly be described as their

wages, they being their own employers. If their wages are to be raised, they must somehow increase one or more of the factors on which their success depends. They must be more diligent in the discovery of materials for which a use can be found; they must become better acquainted with the properties of those materials; they must develop their constructive skill. If they are too primitive to have developed the use of mechanical power, they must do everything with their own hands, guided by their own intelligence and their own feeling for what is beautiful and fitting. At every step enter the qualities that go to make craftsmanship, as I would interpret the term. There is knowledge of materials, there is imagination, there is technical skill; perseverance is wanted, love of the work itself, sympathy with the use that is to be made of it, and with the user. Clearly, on the craftsmanship of the islanders will depend whether they have enough food to go round, enough clothes to wear, whether they have leisure for anything beyond the labour that satisfies their barest necessities.

Of course, this isolated group of people will have some characteristic estimation of what kind of wages they want. Their energies may conceivably be devoted only to the production of things that satisfy bodily desires, or they may be bent also on nobler things. I need not consider that point, as I am not trying to picture Utopia. All that this image is meant to convey is the idea of craftsmanship and its fundamental importance. Nor is the account yet complete; far from it. It is not only that the products of craftsmanship are a necessity if the islanders are to live at all: craftsmanship has a value in itself. There is in men, more in some, less in others, the natural desire to use what faculties they possess. It is a fact that love of good work and delight in successful accomplishment are powerful motives, and when satisfied are sources of real happiness. Of all the motives that sway the world, these are among the purest and best.

The power to produce in plenty what is wanted is, of course, only one of the great problems that a community has to consider. There is also the endlessly difficult question of distribution, of the manner in which each working individual is to receive his share of the wages. The two problems cannot be separated entirely: the means directed to the solution of one contribute to the solution of the other. But I must not attempt too much: science is in the first instance concerned with the production problem; the distribution problem follows.

Let us extend our image a little; let our island be discovered and put into communication with the outside world. An exchange of craft work sets in: the islanders discover new wants that must be satisfied, and they pay for the necessary imports by exporting what they make themselves. But the exports must be made to satisfy the tastes of the outside peoples or there will be no trade. So the islanders now find that they must no longer consider their own tastes entirely: they must accommodate themselves to a more general conception which is only in part their own. It may happen that under the new conditions they become less and less self-contained. Some things which are necessary to life, such as food or clothing, may become imports, being no longer produced, at any rate in sufficient quantity, within the island itself. The people are now very firmly tied to the rest of the world; they must give that they may receive, and they must please in order that others may be willing to take. We may say that their craftsmanship is now judged more critically; and more than ever it becomes fundamental to well-being, even to existence. The conclusion I would draw from this very simple little analogy is that a people lives on what it makes or earns and that its success depends on its craftsmanship. A people cannot expect to be provided for: it has no rights.

Constructive Expression.

I would ask you presently to consider the difference between the craftsmanship of an early civilisation and that of our own more complicated times. But before doing so, let me say yet one or two words about the older forms.

We have a profound feeling for any example of an old craft, and for very good reasons. Among them I do not include the sentimental regret that, in some cases, a past time skill seems to have disappeared. We may be sorry, but after all it is but a receipt that has been lost and may be found again any day, if proper search is made for it. Modern knowledge and methods of analysis are at least good for that much. Nor is the collector's pride of rarity the worthiest feeling that the old specimen inspires.

Our affection for it and the reverential care with which we handle it are due to the fact that it represents to us the labour of a people, labour into which knowledge, imagination, love of beauty, technical skill have all entered. The most of what was once used in everyday life has long disappeared; even such more durable things as houses and ships, roads

and cultivations, may have ceased to be. The few objects that survive must be taken as examples of what has been lost. On the showing of the student, a spirit will emerge from an old vessel as great as that which issued when the fisherman of the "Arabian Nights" unsealed the pot that had long been lying at the bottom of the river. It is the spirit of the bygone people that takes shape before us.

The Greek gave exquisite form to his vase and decorated its surface with equal art. He copied from the growing things of Nature the adjustment of lines and surfaces which give the sense of fitness for a purpose. The outlines of his vases are so perfectly adjusted that their representation in a drawing will not bear alteration by the width of a line. That the Greek should with so much skill take lessons from what his perception made clear to him, and should with so much care choose his materials and mould them to his purpose, is what we should expect from a nation that shows also in its literature a passion for justice and harmony. The fine accuracy of his line is in agreement with his delicate sense of differences in thought and words.

The Roman developed the principle of the arch, and enough remains of what he built to show the daring and the power of his work. The great arches that spanned his public buildings seem to stand for the Roman rule and law under which the whole world might find shelter and be at peace.

The sword of the Indian workman was gradually brought to its temper by an infinite series of local applications of heat alternating with the few blows that could be skilfully given while for a moment it was in the workable state. The poverty of the craftsman's appliances, the meagreness of his little fire and the scantiness of the tools with which he made his way bit by bit to his final achievement, are in consonance with his life of small details ruled by overmastering ideas.

I need not illustrate further. It is indeed well known to everyone that the craftsmanship of a people is an expression of the best of its very self. It is to the underlying reason that I would direct your attention now. The mind of a nation is so expressed because its craftsmanship, interpreted in its widest sense, represents its efforts to live. Under this strong compulsion, the nation produces results which range from pots to poetry, and all its products are stamped alike. That which we do ourselves is as representative as a Greek vase or a Roman aqueduct or a suit of armour from Milan. The craftsmanship of a nation is its very life. Even if we consider it only in relation to the production of material things, the state of a nation's craftsmanship is an index of its health.

Modern Aspects of Craftsmanship.

As a people departs from its primitive condition, so also does its craftsmanship. I would ask you to consider the nature of the change. The elements of craftsmanship in its original form centre round the individual. In his brain are the knowledge and imagination, in his hands is the skill, and round about him lie the materials and the tools of his craft. But as the years go by it becomes impossible that all the knowledge and all the technical skill should be found in one person, and all the tools be owned by him. The craftsman becomes an association of men, a great manufacturing firm, even, we might say, a nation, if all the members of the nation contribute through government intervention and control to the maintenance of some industry. Many hands, working in an alliance which is often unconscious, are employed in bringing a product to its finished form. It is a long step from the simple workshop of the old single-handed craftsman to the vast complex factory of modern industry.

If now we ask ourselves what has brought us to this new kind of modern craftsmanship, this dependence on machinery with its wealth of production, its clattering, bustling activity, and its compelling influence on the lives of all of us, we find that one simple cause has been continuously operative. It is nothing more or less than the urgent wish of the individual to better his own condition; and, in his disinterested moods, the condition of his neighbours. The change could never have been prevented.

When Hargreaves thought that by a mechanical arrangement he could manipulate several spinning-wheels at one time, and succeeded, so that he had more wages to spend on his wife and children, he was obeying a universal and natural impulse. Hargreaves' neighbours, being left behind in the competition for wages, pulled his house about his ears. But in the end they, too, found themselves to be turning many spinning-wheels where formerly they had handled only one. Then they, too, had more money to spend. What other turn could things have taken in the circumstances? What happened in this isolated incident is repeated again and again in every craft, and in consequence change after change marks the road that stretches far from its beginnings.

Quite apart from all considerations as to whether the new is better or worse than the old, more beautiful or less beautiful, whether it calls out the best in man as well as the older ways, or whether it fails to do so, apart from all comparisons of this kind stands the fact that the change is due to natural impulses which will not be gainsaid. The results have to be accepted. We cannot put the clock back. We cannot, let us say, wipe away the great steelworks of the world and replace them by thousands of individuals each with his single anvil and single hammer. We cannot replace the great ships of Glasgow by a multitude of little sailing boats. The plain truth is that modern craftsmanship with all its noise and ugliness is giving food and clothing, warmth and interest, to millions who otherwise must die. It is ungrateful to find fault except with sympathy. Let us try in all possible ways to mend its offences and soften its hardships, but in all honesty let us recognise that we live on modern craftsmanship in its modern form. We are each and every one of us responsible for the present conditions so long as we insist on spending money to the best advantage.

At this point it is convenient to refer to a matter which would be of little importance if it did not seem sometimes to put modern craftsmanship in a wrong light. We are continually discovering examples of the marvellous skill of the craftsman of thousands of years ago. There is here, however, no disheartening implication, as has sometimes been asserted, that men can no longer do what was once in their power. To those who look into what goes on in a factory or a mine, in the field or on the sea, there are innumerable examples of beautiful craft work, beautiful because of their fitness for their purpose, their balance of design, their ingenuity, their history, their growth under human perseverance and thought. Every one of us can bring to mind examples of technical skill demanding imagination and intelligence as well as manipulative power which could be set alongside any instance in history. Let me name only one: could anything surpass the drawing of fibres of quartz, finer by far than a human hair, by means of the bow and arrow? It was a feat to imagine that it could be done, to anticipate that when done it would fill so perfectly an urgent need in the construction of many important instruments, and, finally, to do it.

Now we come to the point at which I would ask you to consider the relation of science to the craftsmanship which I have been trying to define. I would direct your attention to the manner in which, under the urgent drive of self-preservation, the craftsman has called scientific knowledge to his aid. Sometimes the moment has been dramatic on account of the great need of the occasion and the prompt effectiveness of the reply. When, for example, coal-mining was at a low ebb because the mines were becoming waterlogged and no available power was strong enough to clear them, Savery and Newcomen made use of the new discoveries respecting the pressures of gases and vapours which Torricelli and Pascal, Papin and Hooke, had just been examining and trying to explain. The steam engine thus came into being and saved the situation. When, at a somewhat later date, James Watt, by further application of the same physical laws, added fresh powers to the engine, the modern steam engine came into view, with all its applications to railways and steamships and many other marvels of to-day. In 1831, Faraday, in the course of certain systematic searchings, found out the way in which one electric current could bring another into being, the so-called electromagnetic induction. With that single day's work began the whole development of electrical engineering in its innumerable forms. I need not increase the number of my illustrations.

More often it happens that scientific knowledge enters with less instantaneous and startling effect into the history of a craft. It is only when we come to consider the various details of some modern product of craftsmanship that we suddenly realise how closely every detail is connected with the advance of science, and indeed, to be more particular, with the scientific laboratory.

Let us think for a moment of one of those magnificent ships for which the Clyde is famous. Let us survey its various parts in our minds. Its hull of steel recalls the great forges of Britain, and the wealth of research that has been spent in works and metallurgical laboratories on the nature and qualities of steels of all kinds, research which is still in progress. Within are the engines, turbines perhaps, or reciprocating, or it may be internal combustion engines, Diesel or others.

What a range of inquiry and trial and development lies in every detail, depending always on principles of physical and chemical science, tested at every stage by instruments which are a craft in themselves! You may think of the screw and of its design. You picture the curious and most efficient thrust-block by which the force of the screw is brought to bear upon the ship, and remember that Michell lately designed it on the basis of

the physical laws of liquids. You look aloft and see the wireless and are reminded that this sprang directly from the physical laboratory. Your sounding apparatus is based on Kelvin's designs; it may be that you have fitted your ship with the wonderful and still more recent apparatus for sounding by echo, which enables her to find the depth of water, shallow or deep, even when she is travelling at high speed. The War forced this adaptation of the laws of acoustics. She is sure to carry some form of refrigerating apparatus, and now we are reminded of all the investigations into the production of cold by students of science like the Frenchmen Cailletet and Pictet, by Onnes in Holland, and by Dewar, whom, as befits the occasion, I will call a Scotsman rather than an Englishman. So you pass from one great feature of the ship to another, and presently from detail to detail; and you find that the whole structure is linked by innumerable ties to the research work of the laboratories. Craftsmanship in its urgent need has called upon scientific knowledge for aid, and the mighty growth is due to the response. Indeed, it is not only craftsmanship that has grown, but also science itself.

If you hinder the growth of science in any way, you hinder the growth of craftsmanship. Now it is an important fact that science advances over a wide front, and the various branches of it move on together: not absolutely keeping step with each other, but preserving a general line. It has been suggested that science might refrain from development in some directions or, even as our good friend the Bishop of Ripon said at Leeds last year, we might proclaim a ten years' holiday. But you cannot prevent interested men from making inquiry. You cannot prevent the growth of knowledge: you cannot even make a selection of those points of advance which will lead to certain select classes of results. No one knows what is over the hill. The vanguard moves on without any thought of what is before it. That is why, if the march of science is to be conducted in an effective and orderly way, were it only for the purposes of industry, there must always be a certain number of laboratories or parts of laboratories where scientific research has no immediate thought of possible applications.

Science in Industry.

If I read modern industrial conditions rightly, the closeness of the connexion between craftsmanship and science may be illustrated in yet another way. It is, I think, a fact, and a remarkable fact, that the most active of our modern industries are those which are founded on recent scientific research. The most notable is, of course, that of electrical engineering. The year that sees the celebration of our Association's centenary will witness also the ceremonies that commemorate the basic experiment of Faraday. It is difficult to sketch in a few words the great edifices that have been built upon the discovery of electromagnetic induction. We might look upon it financially and picture, as some of my hearers can do, the amount of capital involved in electrical undertakings throughout the world, electric lighting, electric transmission of power, cables, and now wireless, not to mention all the minor uses to which electricity is put. The transference of matter, of intelligence, of thought, of sound, even of vision, is largely dependent on electromagnetic action. If we are not familiar with financial quantities, let us just think for a moment of the change in our lives if every electric current ceased to run; and let us realise that the whole mechanism of modern intercourse would fail, and that populations born to use it would be brought to dire distress.

Though the electrical engineering industry with all its branches may be said to have its source in a single laboratory experiment, yet it has grown by the continuous adaptation of fresh streams of knowledge. The huge American corporations maintain research laboratories costing millions of pounds annually, and find that the financial return justifies their policy. The General Electric Company found that a costly research into the structure of the electric lamp repaid itself over and over again. The very important technical discoveries of Langmuir and Coolidge were consequent upon an attempt to find out what happened on the surfaces of the glass bulb and of the glowing filament. The point is that the electrical industry was not merely launched by a single discovery; it is continually guided, strengthened, and extended by unremitting research.

Consider the very active motor industry. The most important of all the problems connected with the internal combustion engine is that of the nature of the explosion, the effects of varying the mixture, the movement of the gas in the cylinder before the ignition, the actual occurrences at the moment of ignition, the movement of the subsequent explosion wave. The problems are exceedingly intricate. They have been and are the subject of intense research in various laboratories in Great Britain. The research is new and the

industry is new. The construction of the engine depends on the use of alloys possessing the most remarkable properties, all of which were practically unknown until recent researches of the metallurgists brought them to light. The motor car is connected, too, with the laboratories in which chemistry and physics are applied to the study of rubber. Here again is a whole story in itself, which would tell of the work done on the intricate consequences of various kinds of mixings and of treatment, of the vulcanising and of the use of 'fillers.' Not many know the story; they are only aware that motor car tyres last longer than was once the case.

The aeroplane, like the motor car, has become possible because of the advent of the internal combustion engine; but it has a unique feature—its element of romance, its motion through the air. The laws of aerodynamics are becoming better known, and with every advance in their knowledge the efficiency of the aeroplane increases. Their intricacy is gradually resolved, but the process demands, in the first place, mathematical skill, and in the second the fascinating research that is carried on in the wind channels of our laboratories. On this splendid work the progress of the aeroplane depends. I saw not long ago in a London shop window a coloured print of a flying machine. From across the street it might easily have been taken for a drawing of a modern aeroplane; a closer view showed still the same general spread of wings, the same whirling screws, the same discharge from the exhaust, a boat not at all untrue to modern design, and wheels to bear it when on land. Moreover, the proportions were quite familiar. Yet the date was 1843. For all its resemblance to the modern aeroplane, how far it was from flying not only in time but also in capacity! The difference between old and new in the form and materials of the wings may not be obvious to the casual observer, but in reality a wealth of trial and calculation lies between the crude projections of the old invention and the modern machine that flies. The turn of a line in the sectional outline of the wing may make the difference between success and failure, though it is only one of innumerable and equally essential details. The scientific worker grasps the meaning of that turn, and the airman tries it out, and that is the combination which brings success at last. The point is that the construction of the flying machine is a new industry based directly on knowledge recently acquired in the laboratories and continually growing under laboratory experiment. Ever thing depends on this careful, well-informed concentration on essential details.

If we enter the chemical province, we find that there are thriving industries based on recent scientific discovery; instances at least as remarkable as those possessing a more physical basis. The chemical industries are so many and various that even a brief summary is beyond me; yet the whole of them are of comparatively recent origin. Quantitative chemistry is little more than a century old; and the more modern and more vigorous of the chemical industries depend on very recent chemical research, as, for example, those which deal with dyes, explosives, fertilisers, rubber, artificial silk, and many other things. It is the same story: the craft is based on science, and in this case very obviously so. Chemical industries are based on scientific discovery, and lean on it the whole time.

It is natural to compare the condition of the newer industries with the older industries known as basic, because they have long constituted by far the major portion of the country's industrial effort and are still pre-eminent: coal and steel, cotton and wool. In some of these industries there is serious depression. What has the fact to do with science and scientific research?

It is obvious that we cannot say of any industry or craft that its condition depends only on scientific knowledge and imagination. The difficulties of the coal trade are due in large part to the powerful cause of competition. We had a good start in the knowledge of the existence of our coal deposits and in the practice of working them, in the means of distributing coal, and in methods of making use of it. We reaped our harvest. But as time went on other nations gathered way in pursuit of us; they also found coal deposits, they learnt how to work them, and could even improve on our practice because they could profit by our mistakes to a greater extent than we ourselves. They had not so much old machinery to scrap. Means of transit were developed in these countries; in fact we helped to develop them, as also the industries that used the coal. Such conditions must inevitably have tended to diminish our lead. The War acted suddenly and violently in the same direction. It is reasonable, though deplorable, that the industry should find itself in difficulties. The situation is not wholly irremediable, though the older conditions can never completely return. But at least a partial retrievement is possible, and we know that various research organisations, some instituted by the State and some due to private enter-

prise, are grappling with the question involved. It is deeply interesting to see in what way the necessary efforts are being made, and indeed must be made.

Now, whatever is done, and in whatever way it is done, the results of such endeavour, whether related to the coal or to any other industry, depend on those relations between craftsmanship and science which I have been trying to define. I would now consider these relations from one or two separate points of view. In the first instance let me say a word concerning the general connexion between science and that condition in industry which is known as mass production.

SIGNIFICANCE OF MASS PRODUCTION.

It must always be the aim of an industrial organisation to devise and set going one of those systems of manufacture on a large scale with which we have become familiar in recent years. With the aid of suitably designed machinery and methods, great numbers or quantities of some article in general demand can be produced at a comparatively small running cost. Generally, however, the initial cost is heavy, for the designing of the machinery and the planning of the methods call for great experience and skill, and they demand much time spent in the acquirement of the necessary knowledge and its utilisation in design. Once the process is under way it may be possible, and it seems to happen on a sufficiently attractive number of occasions, that a smooth and peaceful running of the machinery brings in the wished-for returns. But every such phase of production comes to a natural end. An improved process is devised, and the new displaces the old. Or it may be a factory is set up in another country where labourers can be hired more cheaply; they may be intrinsically inferior, but that will not matter if they can be drilled into the mechanical process; and, so long as the machine runs true, the standard will not fall below a certain value. The event is in accord with expectation, because men will always try to improve their productivity by the use of new knowledge or more favourable conditions, so that those who fail to recognise the principle will be left behind by those who do not. The stereotyping of some process can be fruitful only for its allotted time. Mass production is in its way splendid, ministering to the necessities and conveniences of many who must otherwise have gone without. But, if it is brought to such a pitch that its processes call for little intelligence in their working, then cheap people of little intelligence will be found, in the end, to be in charge.

The relation of science to mass production is therefore both that of builder and that of destroyer. Mass productions are temporary lulls in the movement of imagination and knowledge. Much skill and thought and care may be required to arrange for one of those quiet and profitable times; the machine is set going and for a while goes by itself. But new applications of scientific knowledge, new ideas, new processes, new machines must always be in preparation. In the parks the gardeners are always nursing fresh plants to take the place of the old, and preparing them for their useful time of flowering. So we see the meaning of the various research organisations which have been set up in the basic industries, such as the Fuel Research Board, the Cotton, the Woollen, and the Silk Research Associations, the research laboratories of the steel masters at Sheffield. Much of our hope for the future is built upon their work.

INDUSTRIAL ADAPTATION.

If craftsmanship, to fulfil its task of providing for the people, must be continually improving its processes, then the nation that is to be successful must possess the means and the will to improve, and here we come, I think, to a notable point. May it not be said that in Great Britain the means exist even to a remarkable degree? Our craftsmen, as a whole, including all grades, are possessed of qualities, intelligence, skill, accuracy, and so on, which make improvement possible. How could our enterprises in the past have been so often successful if this had not been so? How can we be succeeding so well in respect to the new industries of the present if the capacity is not there?

Should it not, therefore, be our policy to take advantage of our country's qualities by continually seeking for fresh industries or fresh adaptations of the old? We should surely not cling unduly to older activities when they have reached the stage in which many others have learnt to do them with equal efficiency, and when we can go on to something new and, it may be, more difficult. We can, of course, bolster up old industries by political methods, and I have no wish to decry such methods as always incorrect. But clearly the best protection of all is the knowledge and skill which can enable us to produce what others must

ask us for because they cannot so well make it themselves.

Absorption of Scientific Discovery.

These considerations lead naturally to a second aspect of the relations between craftsmanship and science. The improvement of craftsmanship depends in large part on the absorption and adaptation of scientific discovery. How is the process to be encouraged?

We here come to a point which must be emphasised with all possible vigour, because its importance is not always realised. Scientific knowledge and experience, if they are to be of full service, must be in direct practical contact with the problem that is to be solved. This must be clear to every one of us from actual experience. If you have expert knowledge on any subject and your advice is asked, your first instinct is, as you all know, to ask to be allowed to see for yourself. It is only when all the circumstances are clear to you in their relation to the difficulty that the solution is likely to suggest itself; and it may take much watching and patient observation before you are successful. It is the combination of actual experience with scientific knowledge that is essential. As the principle is so fundamental, I may be allowed to illustrate it by an actual experience:

It was in the early years of the War that a body of young scientific students from our universities was assembled for the purpose of testing on the battlefield the value of such methods of locating enemy guns as were already known. In their mutual discussions and considerations it became clear to them that the great desideratum was a method of measuring very exactly the time of arrival of the air pulse, due to the discharge of the gun, at various stations in their own lines. If the relative positions of the stations were accurately known, it would then become a matter of calculation to find the gun position. But the pulse was very feeble: how could it be registered? Various methods were considered, and among them was one which no doubt seemed far-fetched and unlikely to be successful. A fine wire is made to carry an electric current by which it is heated. If it is chilled, for example, by a puff of cold air, the resistance to the passage of the current increases, and this is an effect which can be measured if it is large enough. If, then, the hot wire could be made to register the arrival of the air pulse from the gun, a solution of the problem was in hand.

No doubt this method occurred to several members of the company; it was certainly turned over in the mind of one of them who had had considerable experience of these fine heated wires. They had been in use about thirty years, having been employed for the measurement of temperature in many circumstances where their peculiar characteristics gave them the supremacy over thermometers of the ordinary form. But, and this was the important point, was it to be expected that the effect, though it must be there, would be big enough to see? Could the faint impulse from a gun miles away produce an obvious chill on a hot wire? On first thoughts it did not seem likely, and the suggestion lay in abeyance.

It happened, however, that one summer morning an enemy aeroplane came over at daybreak on a patrolling expedition. The officer of whom I have spoken lay awake in his bunk listening to the discharges of the anti-aircraft guns and the more distant explosions of their shells. Every now and then a faint whistling sound seemed to be connected with the louder sounds. The wall of the hut was of felt; it was in poor condition and there were tiny rents close to his head as he lay. The gun pulses made a feeble sound as they came through. This set the officer thinking: if the pulse was strong enough to make a sound, it might be strong enough to chill a hot wire perceptibly. So the method was proposed to the company as worth trying. It was tried, and proved to be a complete success. The sound ranging of the British armies was based upon it, with results which have already been described and are fairly well known.

It is clear that the all-important suggestion could have been made only by a man who had had scientific training and experience. That is one point of the first significance. The second is that it could have been made only by such a man actually on the spot. He could not have realised the details of the problem if he had been anywhere else.

It is worth while to consider this last point a little more closely. What precisely was the difficulty which could be resolved only by a combination of knowledge and of being on the spot? It was really the difficulty of making a true estimation of quantities. It was a question of magnitudes and measurements. Anyone possessed of scientific knowledge could have said, if asked, that a gun must make an air pulse, and that an air pulse would chill a hot wire to an extent which

might or might not be measurable. But there is all the difference in the world between such vague general knowledge on one hand and, on the other, the realisation that such a method is likely to work and give the desired result. It is the difference which so often escapes attention, but everyone of experience knows that it is to be reckoned among the essentials. It is so easy to talk generalities or to think of them, and so difficult to get down to the details which make the effort a success. It may be the last little adjustment of magnitudes that turns the scale, and the last step the one that counts.

Are we, then, in Great Britain, putting our scientific knowledge into the position where it is really effective? I would direct your attention to a most interesting and important movement which is attaining a notable magnitude.

Research and Service.

A new class of worker is growing up among us consisting of the man engaged in research associations and industrial research laboratories throughout the country. We must place a high value on their services, for they are actually and personally bringing back with them into craftsmanship the scientific knowledge which is one of its essentials. They bring the interest and the outlook of scientific inquiry into touch with both employer and employed, and I cannot but think that they may be to some extent the flux that will make them run together. For they can speak with the employer as men also trained in university and college, exchanging thought with ease and accuracy; and, at the same time, they are fellow workers with those in the shops and can bring back there some of the interest and enthusiasm which spring from the understanding of purposes and methods. It is to be remembered always that personal contact has, on the whole, thanks to the better qualities in human nature, a marvellous effect in smoothing out differences. I do not think it is unduly optimistic to welcome the growth of this new type of industrial worker, because it can, being in personal intercourse with both capital and labour, supply to each a new outlook on their whole enterprise, especially as that outlook is naturally illuminating and suggestive. For, after all, this is but going back to first conditions. The primitive craftsman has been replaced by separate persons or groups of persons who have slipped away from each other almost without our realising the fact. In the most recent times the separation has become more obvious and more dangerous, and that is why in so many directions efforts are being made to stem it. Can it be good that the workman has a part demanding little intelligence, merely the capacity to repeat? Can it be expedient that mere manipulation should be left in the shop, while design and imagination have gone into the drawing office and shut the door behind them? Can it be right that the factory directorate should not be in immediate contact with the vast body of scientific knowledge?

The present number of industrial research workers is relatively small; it seems likely to increase, however, in proportion to the extent to which the province of science is better understood. The better understanding I think of as manifesting in the first place in industry itself. I am sure that here it is happily on the increase. There is also a broader view to be taken. There is a public estimation of the value of any calling which affects the numbers and the quality of those who respond.

I doubt if there is in the first place sufficient appreciation of the interests and rewards in the life of a student of industrial research. The pioneers have suffered unnecessary restrictions and discouragements, but their followers will be in better case. Surely it does not need much imagination to realise the splendid side of such work? The succession of fresh difficulties to be overcome, and of new and interesting views into the nature of things and ways of the world; the unforeseen value of results, sometimes an immediate prize, sometimes the clearing of an obstacle in a manufacturing process, never less than the discovery of facts which may some day be of use; the personal association with a living enterprise and with the human spirit behind it. When it is realised that this kind of work is wanted badly, that it is really serviceable to the community, that there is opportunity for devotion, that it is in touch at once with human needs and with the furthest stretches of thought and imagination, it surely takes on to us the final touch of nobility.

We must remember also that the road of the student of science is still none too clear. The very methods of teaching science are a constant subject of discussion. I will say no more now than this: that the best methods must take time to elaborate, and cannot be expected to have arrived at their final form. The difficulty is increased by the fact that science itself grows rapidly, and the extent of its application is only now revealing itself.

That the knowledge of the immensity of Nature and the study of the natural laws have an educative value is well recognised. That science can be used as an educational drill is also known and made use of. But there still remains the human side; the continuous effect of the growth of knowledge upon thought and enterprise: the realisation of the immense part that science is playing in modern life and is likely to go on playing. Education by scientific instruction is still apt to lack the comprehension of the human side, without which the classroom is a dull place.

There are even some who think that science is inhuman. They speak or write as if students of modern science would destroy reverence and faith. I do not know how that can be said of the student who stands daily in the presence of what seems to him to be infinite. Let us look at this point a little more closely.

The growth of knowledge never makes an old craft seem poor and negligible. On the contrary, it often happens that under new light it grows in our interest and respect. Science lives on experiment; and if a tool or a process has taken shape from the experience of centuries, science seizes on the results as those of an experiment of special value. She is not so foolish as to throw away that in which the slowly gathered wisdom of ages is stored. In this she is a conservative of conservatives.

Progressive Science.

What is true of a tool or process is true also of those formulæ in which growing science has tried to describe her discoveries. A new discovery seems at first sight to make an old hypothesis or definition become obsolete. The words cannot be stretched to cover a wider meaning. By no means, however, is that which is old to be thrown away; it has been the best possible attempt to express what was understood at the time when it was formed. The new is to be preferred for its better ability to contain the results of a wider experience. But in its time it will also be put aside. It is by a series of successive steps that we approach the truth: each step reached with the help of that which preceded it.

Nothing in the progress of science, and more particularly of modern science, is so impressive as the growing appreciation of the immensity of what awaits discovery, and the contrasted feebleness of our ability to put into words even so much as we already dimly apprehend. Let me take an example from the world of the physical sciences. There is a problem of which the minds of physicists have been full in recent years. The nineteenth-century theory of radiation asks us to look on light as a series of waves in an all-pervading ether. The theory has been marvellously successful, and the great advances of nineteenth-century physics were largely based upon it. It can satisfy the fundamental test of all theories, for it can predict the occurrence of effects which can be tested by experiment and found to be correct. There is no question of its truth in the ordinary sense.

In the last twenty or thirty years a vast new field of optical research has been opened up, and among the curious things we have found is the fact that light has the properties of a stream of very minute particles. Only on that hypothesis can many experimental facts be explained. A wave theory is of no use in the newer field. How are the two views to be reconciled? How can anything be at once a wave and a particle? I do not believe that I am unjust to any existing thinker if I say that no one yet has bridged the gap. Some of you who were present at the Liverpool meeting may remember that Bohr—one of the leading physicists of the world—doubted if the human mind was yet sufficiently developed to the stage in which it would be able to grasp the whole explanation. It may be a step forward to say, as we have been saying vaguely for some years, that both theories are true, that there are corpuscles and there are waves, and that the former are actually responsible for the transference of energy in light and heat, and for making us see; while the latter guide the former on their way. This is going back to Newton, who expressed ideas of this kind in his "Opticks," though he was careful to add that they were no more than a suggestion.

We are here face to face with a strange problem. We know that there must be a reconcilement of our contradictory experiments; it is surely our conceptions of the truth which are at fault, though each conception seems valid and proved. There must be a truth which is greater than any of our descriptions of it. Here is an actual case where the human mind is brought face to face with its own defects. What can we do? What do we do? As physicists we use either hypothesis according to the range of experiences that we wish to consider. To repeat a phrase which I employed a few years ago in addressing a university audience familiar with lecture timetables, on Mondays, Wednesdays, and Fridays we adopt the one hypothesis, on Tuesdays, Thursdays, and Saturdays the other. We know that we cannot be seeing clearly and fully in either case, but are

perfectly content to work and wait for the complete understanding.

When we look back over the two centuries or so during which scientific men have tried systematically to solve the riddle of light, or even go further back to the surmisings of philosophers of still older time, we see that every conscientious attempt has made some approach to the goal. The theories of one time are supplanted by those of a succeeding time, and those again yield to something more like the first. But it is no idle series of changes, of vagaries of whimsical fashion; it is growth. The older never becomes invalid, and the new respects the old because that is the case.

Surely it is the same in regard to less material affairs. The scientific worker is the last man in the world to throw away hastily an old faith or convention, or to think that discovery must bring contempt on tradition.

There is a curious parallelism here to a relation between science and industry of which I have already spoken. Just as any particular case of mass production can be regarded as a temporary condition which the growth of knowledge brings about, and in the end supersedes, so also it may be said of any law or rule or convention or definition that knowledge is both the parent and eventually the destroyer. Time devours its own children. Even if a statement retains its outward form, its contents change with the meanings attached to its terms: and change, moreover, in different directions when used by different people, so that constant re-definition is necessary. How much more is this the case when the contents themselves have to be added to. The distinction between truth itself and attempts to embody it in words is so constantly forced upon the student of science as to give his statements on all matters a characteristic form and expression. This is, I think, one of the reasons why men are often needlessly alarmed by the new announcements of science and think they are subversive of that which has been proved by time.

To this consideration I may add yet one more, which may be illustrated by the same analogy. Scientific research in the laboratory is based on simple relations between cause and effect in the natural world. These have at times been adopted, many of us would say wrongly, as the main principle of a mechanistic theory of the universe. The relation holds in our experimental work; and so long as it does so, we avail ourselves of it, necessarily and with right. But just as in the case of research into the properties of radiation we use a corpuscular theory or a wave theory according to the needs of the moment, the two theories being actually incompatible to our minds in their present development, so the use of a mechanistic theory in the laboratory does not imply that it represents all that the human mind can use or grasp on other occasions, in present or in future times.

Ultimate Aims.

The proper employment of scientific research is so necessary to our welfare that we cannot afford to allow misconceptions to hinder it; and the worst of all are those which would suppose it to contradict the highest aims. Science, as a young friend said to me not long ago, is not setting forth to destroy the soul of the nation, but to keep body and soul together.

Some perhaps might say that in considering science in relation to craftsmanship I am pressing the less noble view; that I am not considering knowledge as its own end. It is said that uselessness in science is a virtue. The accusation is a little obscure, because it may justly be said that knowledge is never useless. If I have thought of science in relation to craftsmanship, it is because I have tried to set out the vast importance of what craftsmanship means and stands for. I have not forgotten that there are other aspects of the inquiry into the truths of Nature. Indeed, I could not carry out the lesser task without considering the whole meaning of science.

No clear line can be drawn between pure science and applied science: they are but two stages of development, two phases which melt into one another, and either loses virtue if dissociated from the other. The dual relation is common to many human activities and has been expressed in many ways. Long ago it was said in terms which in their comprehensiveness include all the aspirations of the searcher after knowledge: "Thou shalt love the Lord thy God with all thy heart, and with all thy soul, and with all thy mind"; and "Thou shalt love thy neighbour as thyself.". In the old story, every listener, from whatever country he came, Parthians and Medes, Cretans and Arabians, heard the message in his own tongue. A great saying speaks to every man in the language which he understands. To the student of science the words mean that he is to put his whole heart into his work, believing that in some way which he cannot fully comprehend it is all worth while, and that every straining to understand his surroundings is right and good; and, further, that in that way he can learn to be of use to his fellow men.

Summaries of Addresses of Presidents of Sections.[1]

The Volta Effect.

In his presidential address to Section A (Mathematics and Physical Sciences) on the Volta effect, Prof. Alfred W. Porter endeavours by a re-statement of the problem, approached from the thermoelectric point of view, to make clear what the usual equations represent. The usual equation for the electromotive force in a thermoelectric circuit is not a description of what occurs at different points of any one circuit, but is an equation connecting together the e.m.f.'s of distinct circuits for which the terminal temperatures are different. Much of the confusion which abounds in the Volta controversy is due to inattention to this fact. Another source of error arises from the assumption of 'perfect gas' relations for cases to which such relations do not apply. It is not true, in general, that the external work done by a system (at constant temperature), and the heat taken in by the system, are a measure of one another. It would be true for a 'perfect gas'; but even this is an ideal case, and for real gases it is not true. Nor is it even approximately true in the majority of systems: examples are given to illustrate its failure. Consequently, it is quite unsafe to take the supposed equality of the heat and external work as a starting-point for discussions on the Volta effect.

Modern developments in electricity have made the thermodynamical arguments much more cogent than they were in Maxwell's days, when the substantial nature of electricity was regarded as a provisional hypothesis which might ultimately be dispensed with. There is now no doubt about its corporeal character—using the adjective in the sense in which we apply it to other forms of matter. The term specific heat applied to electricity means now just what it means when applied to iron: but it has to be remembered that when inside a metal, the electricity (from the thermodynamic point of view) is in a solution. It is therefore the properties of solutions that need to be considered. The boundary between zinc and copper acts as a semi-permeable membrane, since the electrons and nothing else get through it. There is a difference of pressure (or potential) between the two sides. The electrons can also escape to some extent from the sides of the wires, that is, they have a vapour pressure. If the temperature is raised this evaporation becomes very conspicuous as thermionic emission. When equilibrium exists between two metals, the vapour pressure of the electrons must be the same for both. To such cases Margules' thermodynamical theorem must apply. By applying this theorem to simple cases, results are obtained very similar to those obtained by applying Boltzmann's theorem. Moreover, the latent heat of transference of electricity from one metal to the other is connected with the specific heats of electricity in the two metals.

When we pass to electrolytic regions, that is, voltaic cells, there is much more uncertainty as to what happens at the boundaries. Physical chemists, under the influence of Debye, are revising their conceptions in regard to solutions. The old dissociation theory assumed that positive and negative ions moved about quite freely except when appropriate collisions occurred when combination might take place, the amount of combination being calculable from the law of mass action. Debye, however, assumes complete dissociation (at least for dilute solutions), but with attraction between the ions due to their charges. Philosophically, there is not much distinction between the old and the new conceptions. The numerical results, however, are different as calculated by the two methods.

At a boundary between metal and solution no electricity gets through except as a rider on an ion. At least this must be so in all cases in which Faraday's laws of electrolysis are valid.

On the other hand, the boundary between two solutions (for example, in a Daniell's cell) acts as a membrane more nearly of the metallic kind. Electrons riding on an ion in one solution get through, leaving their mounts behind and seizing others in the second solution. It is not unlikely that the voltage there may be of the same order as that at the outside copper–zinc junction but of the opposite sign; for in both cases electrons alone are passing. If this is so, then the electromotive force of a circuit may, at least approximately, be the sum of those arising at the metal–liquid junctions.

It is necessary to be cautious and to avoid dogmatism on the question of the voltages at the individual boundaries. Much more detailed experimental knowledge is required before the electric circuit is really understood. The electronic theory in metals still has its difficulties, which it is of no use to ignore. On the other hand, the experimental difficulties in connexion with the direct

[1] The collected presidential addresses delivered at the meeting are published under the title "The Advancement of Science, 1928." The volume is obtainable at the Glasgow meeting for 4s. 6d., or at 6s. of all booksellers or from the British Association, Burlington House, London, W.1.

determination of the Volta effect are also very great, as all who have made experiments on it know.

Though the voltage at the metal–metal junction is likely to be much larger than the chemical school demanded, there is nothing to justify one in going to the opposite extreme and expecting that the *whole* of the electromotive force of a circuit is located at that junction. Opposing schools should take comfort in the thought that in some respects they are both right.

Fluorescence, Phosphorescence, and Chemical Reaction.

Prof. E. C. C. Baly, president of Section B (Chemistry), has selected for his address the fascinating subject of phosphorescence, fluorescence, and chemical reaction, a field of study in which observations of high accuracy concerning the physical properties of molecules, in contradistinction to those of atoms, have been made. In his survey of the results already obtained and the trend of research, Prof. Baly states that the present position is very far from being satisfactory. On one hand, large and increasing numbers of photochemical reactions which are obviously stimulated by the absorption of radiant energy are known ; on the other hand, the radiation hypothesis, which is based on premises apparently theoretically sound, has been proved to be untenable, so that the general consensus of opinion has swung over to activation by collision in thermal reactions. He has therefore 'exhumed the body' of the radiation hypothesis, in order that the cause of death might be more fully investigated.

Summarising the position, Prof. Baly says that the radiation hypothesis states that the first stage of a chemical reaction is the activation of each molecule of the reactant by the absorption of one quantum of energy. Photoluminescence evidence supports the reality of this critical quantum of activation, but not the supposition that the molecule gains this quantum by a single absorption process. The 'exhumation,' however, of the radiation hypothesis raises the question of thermal reactions in an even more acute form than previously. Unless some mechanism exists whereby a molecule can gain its critical quantum of activation from a source of infra-red radiation, photochemical activation must be viewed as an abnormal event and the radiation hypothesis must be promptly re-interred.

Prof. Baly next refers to experiments on the photosynthesis of carbohydrates. Carbonic acid in aqueous solution is not acted on by white light, and when adsorbed on a coloured surface does not react in the dark, but when adsorbed on a coloured surface and irradiated by white light it reacts to form carbohydrates. Hence the complete activation of the carbonic acid must take place in two stages : partial activation by adsorption with formation of a molecular state capable of adsorbing some rays within the visible spectrum, whereby the activation is completed by photochemical means. Further, the number of partly activated molecules which are able to enter into the final reaction is in linear proportion to the temperature. Evidently the adsorption process alone is not sufficient to bring the molecules into a state which enables them to react photochemically under the influence of visible light, the supply of heat energy being necessary to complete the partial activation. The hypothesis that a complex, A^-B^+, where B has gained its critical quantum of activation at the expense of the rotational energy of A, is formed is, however, applicable both to the synthesis of carbohydrates and, for example, to the behaviour of phenolic ethers with sulphuric acid. It also offers an explanation of the phenomena of photoluminescence. Moreover, this hypothesis is supported by the fact that the most effective method of deactivating an activated phosphor is by exposing it to infra-red radiation.

Prof. Baly considers that the success which has attended the application of the hypothesis of complex formation justifies its general application to all thermal chemical reactions, and that the known catalytic activity of water in inorganic chemical reactions may be connected with its great ionising power, for it is possible that ionisation itself is the result of complex formation between solvent and solute.

The Palæozoic Mountain Systems of Europe and America.

Mr. E. B. Bailey's presidential address to Section C (Geology) is a natural development of the writings of Suess and Bertrand. It deals with folded mountains, and explains that geologists can recognise such mountains by their internal structure even where old age has deprived them of their original height and form. Both in Europe and North America, there are immense regions that have escaped mountain-folding since the dawn of the Cambrian. In Europe we find Baltica, a triangular area with its base along the Urals and its apex in South Wales. In North America the corresponding area is Laurentia, situated between the southwardly convergent Atlantic and Pacific mountain belts.

The north-western edge of Baltica is furnished by the Caledonian Chain of Britain and Scandinavia. The folding of this chain is of early Palæozoic date, not later than Devonian. Törnebohm has described its south-eastward overthrusting on to Baltica in Scandinavia ; Callaway, Lapworth, Peach and Horne, its north-westward overthrusting on to the European representative of Laurentia, in the north-west Highlands of Scotland. This last relation recurs in Newfoundland, maritime Canada, and northern New England, as demonstrated by Logan.

Throughout the address, emphasis is laid on subsidence preparatory to mountain-building (Hall, Dana, Haug). This subsidence originates and maintains tectonic slopes. Where sediment is delivered at the top of such a slope, it may be sorted out through arrest of its coarser material in deep water. Where sediment is delivered at the foot of such a slope, it remains at the bottom, and any submerged platform at the top of the slope may

therefore furnish a propitious site for the growth of clear-water limestone. The former condition is illustrated in the preparatory history of the Southern Uplands of Scotland, elucidated by Lapworth; the latter in that of eastern Canada.

The more southerly of the two chains which meet about the western angle of Baltica in South Wales belongs to the Hercynian System of Carboniferous date. Its northward overthrusting in Belgium has often been described. The history of its preparatory subsidence is reflected, first, in the geographical distribution of Old Red Sandstone and marine Devonian, and secondly, in that of the Carboniferous Limestone and Culm facies of the Lower Carboniferous.

The Hercynian Chain begins to cross the main Caledonian Chain in South Wales and Ireland. The process is continued in southern New England. In Pennsylvania the Hercynian Chain steps clear of its Caledonian predecessor and marginally overrides Laurentia. Of late years, Wegener has developed the idea of continental drift on a grandiose scale. He has accounted for many recognised correspondences in the geology of the two sides of the Atlantic by supposing that the ocean has flowed in between the Old World and the New, as the two continental masses, with geological slowness, drift asunder. One cannot help feeling that Wegener may perhaps be telling us the truth. The available evidence is crude and ambiguous; but it is certainly startling to be confronted on the coasts of Britain and New England with what read like complementary renderings of a single theme: the crossing of Caledonian Mountains by Hercynian.

Origin and Evolution of Larval Forms.

In his address to Section D (Zoology), Prof. W. Garstang selects the Mollusca as a large and representative class of marine Invertebrata, and after a survey of the larval forms within the group, puts forward certain general results which define his point of view. Haeckel's 'Biogenetic Law' is rejected as inconsistent with the unity of the inheritance established by modern genetics ("The Child is father of the Man"). The larva is regarded as a specially locomotive phase of the life-history with a double task, to distribute the species, and to grow up into the adult; but the extent to which a given larva proceeds with the development of adult characters during its pelagic career is conditioned by its ability to carry the additional weight. The primary larva in each order of Mollusca is a simple trochosphere like that of Annelids. It later develops the adult characters of shell and foot to a degree which varies with the power of its locomotive girdle or prototroch. The larva of *Chiton*, with a weak girdle, develops merely the cuticular rudiments of its shell-plates, but no foot; those of *Dentalium* and *Yoldia*, with a large girdle, develop the complete adult form. In the higher and more modern types of Bivalve and Gastropod, the larva, equipped with an extended velum, is provided with shell and foot from the first; and these organs—which in the more primitive groups (*Chiton*, *Dentalium*) are mere anticipations of adult form and larval encumbrances—now become integral parts of the larval organisation, thus creating a new and higher type of larva (*e.g.* veliger).

The question is then raised how far the modification of incipient adult characters can be carried in a larva without breaking the unity of the inheritance and affecting the final form. Temporary modifications of shell and foot are easily rectified by later growth, but what if the larval modification involve the internal organisation and rectification be impossible?

Prof. Garstang claims the torsion of Gastropods as a case in point. Torsion makes the Gastropod. In the adult sequence, as expressed in classification, torsion appears as a true saltation, complete from the first, with no trace of intervening stages. In the development of limpets it has been shown by Boutan to take place suddenly during the free larval life, apparently by a muscular twist, which in the course of two or three minutes reverses the relations of head and foot to the developing mantle-chamber. It thus provides the larva for the first time with a space into which its head and velum can be instantaneously withdrawn on the approach of danger, under cover of a pedal operculum hitherto lacking. In higher Gastropods this rapid larval mode of development is replaced by a more gradual growth-process during the embryonic period. The facts accordingly point to the origin of torsion from an adaptive larval mutation, the persistence of which into the adult stage transformed an early creeping Mollusk into the first Gastropod.

The rest of the address is devoted to corroborative evidence, largely based on the significance of the 'marginal slit' which has characterised mantle and shell of Zygobranchiate Gastropods from Cambrian times to the present. The early development of this slit at the outset of the adult life is regarded as the response of the adult to the unsatisfactory respiratory conditions imposed upon it by the rotation of the branchio-cloacal chamber from back to front, where the free exit of water was blocked by the animal's head and neck. In limpets a new set of gills has been developed outside the chamber altogether, while Azygobranchiates have sacrificed the right gill, and set up a single direct current through the chamber, in place of the original double one. All the evidence, therefore, direct and indirect, points in the same direction: torsion was not developed step by step in the interest of the adult, but suddenly in that of the larva, while the adult adapted itself to the results of the mutation, and created the primary suborders of Gastropoda by so doing.

Ancient Geography in Modern Education.

Prof. J. L. Myres deals in his presidential address to Section E (Geography) with aspects of ancient geography in modern education. Retrospect of the gradual recognition of the educa-

tional value of geography, and anticipation of the further changes which the 'next phase' should require, both in preparatory and in adolescent education, justify re-formulation of the scope and function of geography as co-partner with history in the distributional study of the factors in Nature which the departmental sciences, both 'physical' and 'moral,' respectively study in isolation. In such distributional study the regional or geographical aspect is inseparable from the chronological or historical, both in research and in all phases of utility as an element in education. Both the 'physical' and the 'moral' sciences acquire regional and historical aspects as soon as they come to be applied to human ends and problems, and their systematic treatment should be (and often has been) supplemented by regional and historical examples. But there is need, and frequent opportunity, for fuller correlation of programme, and co-operative team-work among teachers of geography, history, and the departmental 'pure sciences.'

Geographical teaching, like historical, is necessarily regional, and regional studies traverse and interconnect the study of historical periods. Principal illustrations of this are: (1) in the study of the 'home-land,' which is (or should be) central in primary education; in the study of the historical 'legacies' of the cultures (2) of Israel and (3) of Greece and Rome, on which modern European civilisation rests in all its higher aspects. Both these cultures owe most of their characteristics to the regional peculiarities of their 'home-lands,' and are imperfectly presented or appreciated when the geographical presentation of these is neglected.

All phases of education, therefore, which include study of 'biblical' or 'classical' history or literature, need to be co-ordinated with the geographical study of the Mediterranean region and the Nearer East. For the full significance of the national experience of Hebrews or Greeks is only realised when presented as a career of acclimatisation; in Israel, of a nomad-pastoral folk plunged into a sedentary agricultural regime and thereafter exposed to competing influences of neighbouring cultures, Babylonian, Egyptian, Assyrian, and Persian; in Greece, of diverse ethnic ingredients interfused in the highly specialised environment of the Ægean archipelago. Comparative geographical study of the same regional surroundings at successive historical periods has the further advantage of emphasising the reaction of human societies on their environment, especially the exhaustion of natural resources, and transfigurement of what passes in long-civilised countries for 'open country-side.'

For historical reasons, connected with the political history of the Near East, and the social history of our own country, the correlation of studies which was normal at the Revival of Learning became obsolete later, and the present problem is how best to restore it without overloading the time-table. The divorce between geographical study and the humanities being most serious in the 'classical' curriculum, through which the majority of educational administrators pass, as well as most of the teachers in higher secondary schools, it would seem that reform is most urgent at this point. Specific suggestions are: (1) systematic training in map-work throughout; (2) correlation of classical courses with the geography of the Mediterranean and the biblical study with that of the Near East; (3) more frequent reference to geographical literature of all periods, to supplement text-book instruction and encourage 'geographical thinking'; (4) initial and persistent recognition that geography as a science rests on observation and field-work, without which class-room teaching is sterile.

Increasing Returns and Economic Progress.

In the course of his presidential address to Section F (Economic Science and Statistics), Prof. Allyn Young points out that the older economists thought that increasing returns (increased output *per capita* as the total output grows) were characteristic of manufacturing industries, taken as a whole, but not of agriculture. Modern economists have probed into the details of the processes through which increasing returns are secured and have tried to ascertain just how the prices of commodities produced under conditions of increasing returns are determined. In particular, they have scrutinised the economics which come with the growth of the size of individual firms and of particular industries. Unfortunately, in the course of these special inquiries, the problem of increasing returns has been confused with other problems, such as the problems of monopoly and of industrial combination, and the larger features of the economic changes which account for increasing returns have been obscured. Increasing returns are primarily a matter of large production and only incidentally a matter of 'large-scale' production or of the size of individual firms or even of particular industries.

The secret of increasing returns is still to be found in Adam Smith's theorem that "the division of labour depends upon the extent of the market." The most important form of the division of labour is found in the use of what are called indirect, roundabout, or capitalistic methods of production. 'Mass-production' is a relative term. All roundabout methods involve a larger or smaller degree of mass-production. The degree in which it is advantageous to use such methods depends always upon the extent of the market. Mr. Ford's methods would be wasteful in a small automobile factory for precisely the reasons which would make it wasteful to construct a hammer to drive a single nail. The relatively high productivity of labour in a number of representative American industries is to be explained, of course, by the extent of the domestic market, unimpeded by tariff barriers, which is open to them, rather than by any superior efficiency on the part of their management.

The market grows, not only with geographical extension and the increase of population, but also with the general growth of production. In one sense, therefore, the division of labour depends upon

the prior division of labour. Once set in motion, economic progress is continuing and cumulative. Even in the absence of the discovery of really new technical processes, increasing returns would be sure to continue to be realised—within the limits imposed by the scarcity of necessary natural resources. While there is, then, no effective tendency towards economic equilibrium, there is, nevertheless, an effective tendency towards an equilibrium rate of progress. Both the technical and the psychological costs of securing an increased annual national dividend increase disproportionately if the rate of change is accelerated beyond a certain point. This does not mean that increasing returns are illusory, that their advantages are negatived by their costs. Because a mountain climber adjusts his pace to his physical powers and to the conditions of the ascent, it should not be inferred that he might as well have stayed at the foot.

Engineering and Civilisation.

Under the title of "The Influence of Engineering on Civilisation," Sir William Ellis deals in his presidential address to Section G (Engineering) with the interesting subject of the direct association during the latter part of the last century between engineering and the amenities of modern life resulting from the great developments which have taken place in all branches of engineering. The address sets out very clearly how dependent civilisation is on each and all branches of engineering.

In connexion with civil engineering, it is pointed out that the very existence of the population in our large cities in health and comfort is to a large extent dependent on the work of the civil engineer in ensuring an ample and reliable supply of water of good quality and an efficient drainage control. The prosperity of various countries has largely resulted from irrigation works, in many cases the development of produce-growing being limited only by the fact that irrigation works have so far been insufficient. The work of the civil engineer appears also in the construction of larger docks and harbour basins rendered necessary by the great increase in the tonnage of ocean-going vessels and the designing of bridges for carrying the heavy traffic brought about by the development of railways all over the world, many of them in difficult mountainous countries.

Great changes have been brought about in railway transport in the last fifty years, and this side of engineering is of importance to the potential wealth of the great corn-growing countries. The growth of road transport has a direct bearing upon the railways, and attention should be given to the desirability of the construction of by-pass roads to divert heavy traffic from passing through towns and villages.

There have been wonderful developments in tonnage and horse-power of ocean-going vessels; and the safety and comfort of travelling to-day, compared with forty years ago, have been greatly increased. Sir William Ellis alludes to the great services which the engineering branch of the Navy rendered in the War, and to the developments which are taking place in connexion with internal combustion engines and the use of higher pressure steam for boilers.

The activities of mechanical engineers have led to many remarkable advances. Reference is made in the address to the advent of a new type of tool steel, and a suggestion is offered to machine toolmakers that they should keep more in touch with the actual users of the machines, who from time to time may have useful ideas based on personal knowledge of the output of the machines.

Sir William Ellis refers also to the progress of mining engineering and the use of electricity and compressed air engines in underground workings. The various developments of electricity, the telegraph, the telephone, electrical driving, lighting, etc., have contributed greatly to improve the domestic amenities of the general population. The wider use of electricity, both for lighting and heating, would be of great advantage for reasons of cleanliness and health. An interesting reference is made to the introduction of the telephone by Prof. Graham Bell at the British Association meeting in 1877. The address also refers to the great services which the introduction of radio has brought about to ships at sea.

Scottish Archæology.

Sir George Macdonald in his presidential address to Section H (Anthropology) deals with some aspects of the archæology of Scotland. Its systematic study may be said to have begun in 1780, when the Society of Antiquaries of Scotland was founded by the eccentric Earl of Buchan. Smellie's very complete contemporary "Account" of this foundation, and of the institution of what is now the National Museum of Antiquities in Edinburgh, shows how crude were the beginnings of what has since developed into one of the finest prehistoric collections in Europe. The process by which the dilettante is transformed into the scholar, the antiquary into the archæologist, is very much the same in all countries. But Scottish archæology was peculiarly fortunate in that its infant footsteps were guided by a man of the exceptional capacity and gifts which characterised the late Dr. Joseph Anderson. His memorable series of Rhind Lectures, delivered forty or fifty years ago, placed the subject once for all on a solid, because a thoroughly scientific, basis.

Anderson's analysis revealed the fact that, while the archæology of Scotland had much, very much, in common with that of other areas, it also presented certain features which had no parallel elsewhere—the brochs, for example, a notable group of earth-houses, the curious carved stone-balls, the massive bronze armlets, the so-called 'Pictish' symbols, and the heavy silver chains on which these last occasionally appear. As compared with the southern half of Britain, too, Scotland enjoys a great advantage in respect of the abundance of prehistoric material still available for study. The Royal Commission on Ancient Monuments is

collecting much valuable information as to its distribution. But there remains a great field for excavation, properly organised and conducted.

Meanwhile, it is worth while asking how this wealth of material is to be accounted for. That so large a proportion should have survived is not surprising. The prehistoric settlers had naturally selected the treeless areas, and in Scotland the areas which were treeless in prehistoric times are precisely those which lend themselves least readily to cultivation under modern conditions. Many monuments which would have been swept out of existence by the plough have thus been spared all damage save that of natural decay. This, however, is only one side of the problem. It is more difficult to explain the relative density of the population that seems to have tenanted districts like the Western Islands, Sutherland, Caithness, the Orkneys and the Shetlands in prehistoric times.

It has been suggested that metal was the lure which attracted these early immigrants. The suggestion has about it the glamour of romance. But the area is not metalliferous, and, even if it were, one would still have to reckon with the neolithic wanderers. Geographical conditions afford a much more likely clue. In those far-off days the English midlands were thickly wooded, while the way through central Scotland was barred by swamps and morasses and, above all, by the Caledonian forest. The stream of population that moved northwards along the western fringe of Europe seems to have travelled through Ireland by way of the Western Islands into Scotland. There is archæological evidence to show that the Scots were by no means the earliest invaders. What had happened long before is fairly obvious. The set of the current of migration was always towards the north. At intervals a surplus of humanity would be spilled from Ireland, and for the folk who were thus driven out there would be but one open road. That road, however, was a cul-de-sac. Those who followed it would find that northern Scotland was literally the end of the world. When they reached Unst, they would scan the horizon in vain for any sign of land to tempt their frail craft farther. The ocean was for them an insurmountable barrier. As the pressure from the south increased, congestion in the rear of the barrier would be inevitable. That is why prehistoric monuments are so numerous in a region that is but sparsely peopled to-day.

Relation of Physiology to Other Sciences.

In his presidential address to Section I (Physiology), Prof. C. Lovatt Evans discusses the relation of physiology to other sciences. Physiology has a threefold appeal, in its relations to medicine and philosophy, and as a science with a distinctive position of its own. Physiological knowledge has always had the closest association with medicine; clinical observations and deductions drawn from them have shown that disease is always the result of a quantitative change in some physiological process. Athough there have been many striking advances in treatment during the last few decades, yet true discoveries, as distinct from inventions, are probably the results of chance observations, which lead to the formation of hypotheses, later deliberately tested by experiment; but it is given only to the few to realise the relationships of such chance observations and so to make the discovery. The importance of experiment in the ascertainment of physiological knowledge is stressed; in fact, no medical man can adequately treat his patient without utilising, at every turn, knowledge derived from animal experimentation and obtainable in no other way.

Advance in knowledge leads to specialisation, and the difficulties of selecting suitable minimum requirements of knowledge for the student in the different branches are increased; their solution appears to lie in modification of the present examination system and, on the part of the teacher, a proper perspective of the relation of his own subject to the requirements of the curriculum as a whole. It is impossible to give the average student such physiological training as will fit him to carry out research; those who wish to take it up must spend a further year or two in studying the subject.

Physiology takes its place as a science in proportion as its data are accurate and its principles fall into line with those in other sciences. With improvement in the accuracy of its methods, and by progress in the formulation of its problems, mathematics can be profitably employed in the manipulation of its data, but only when it leads to clarification of thought in both the author and his readers. Thus, help is obtained by the application of the theory of errors when the interpretation of a group of physiological experiments is rendered difficult by the occurrence of chance variations; important conclusions should not be drawn from a few observations unless the conditions are so well controlled that individual chance variations can only occur to a slight extent. Similar considerations affect the application of the other exact sciences in physiology. Physiology is something more than biochemisty and biophysics; it is, and always will remain, a biological subject.

Thus the exact sciences cannot furnish an explanation of physiological phenomena, nor, without direct reference to physiological facts, can they allow of their prediction. Pure physics, chemistry, or mathematics would not have enabled physiologists to predict the physico-chemical equilibria in blood, since these adaptations depend, among other things, on the presence of membranes round the red blood cells, the properties of which could only be determined by experiment. Once the phenomena were known, it was possible to describe them more accurately in physico-chemical language.

In discussing the philosophical position of physiology, it is pointed out that mechanistic interpretations of life tend in the long run to become superficial as the vitalistic ones predispose to scientific nihilism. It is unnecessary to attempt to decide between these two opposed views of the nature of life. Physiology should adopt a new point of view; the idea of adaptation should be

taken as its basal principle. Life is conserved by adaptation, and it is essential to treat the organism and its environment as one if a proper insight into the adaptations manifested by the former is to be attained.

Psychology of Skill.

The subject discussed by Prof. T. H. Pear, in the presidential address to Section J (Psychology), is "The Nature of Skill." In the many studies of skill for the purposes of pure theory, education, industry, and sport, the word seems to have covered a heterogeneous collection of performances. In this address an attempt is made to give some idea of the mental and bodily happenings which constitute skill; to supply a scientifically useful meaning for the term, by filtering the popular meaning and rejecting irrelevant ones.

The definition of skill proposed is "an *integration* of well-adjusted performances." This will mark off skill from a mere congeries of habits, which might or might not be well-adapted. A habit is further defined as "an acquired specific response to a specific situation." Experimental work upon transfer of training has shown the futility of the concept of 'general habits.' The essence of habit, if the term is to retain any relation to ordinary language and remain useful, is specificity.

It would be premature to speculate upon the relation of skill to conditioned reflexes. Possibly they stand at opposite ends of a long scale of transition. The impressive fact that to ensure the certain conditioning of a reflex, the control of external surroundings must be complete, contrasts with the amazing difficulties against which a human being may acquire high-grade skill.

Skill implies the power, or powers, of 'patterning' responses. Of this an interesting form is 'knack,' which is discussed in detail, as well as the relation of human skill to natural aptitude. Many features attributed to skill in games and sports are, to borrow the language of logic, 'accidents' rather than 'propria.' This is even more true of skill in industry, where definite agreement concerning the nature of skill seems needed, a subject which will be discussed at the joint meeting of Sections F and J on Sept. 10. Owing to this ambiguity, many discussions concerning skilled trades, skilled jobs, skilled workmen and the disappearance of skill, are of little scientific interest. A classification of skills is attempted in the address.

The relation of intelligence and intellect to skill—a problem obscured by the current phrases 'clever with one's hands' and 'clever with one's head'—is discussed. It is suggested that many psychologists and intelligence testers have too little respect for the intelligence which thinks in terms of things rather than symbols for things. Abstract thinking is not confined to the use of auditory and visual symbols.

The relation between different 'muscular' or motor abilities, and the transfer of training from one ability to another, are discussed in the light of recent experimental investigations.

Sex and Nutrition in the Fungi.

In 1927 the president of Section K (Botany) dealt with the elementary types of holophytic plant life; this year attention is turned to saprophytic and parasitic forms. These have sometimes been assumed to be derived from diverse phyla of green plants, but Prof. Dame Helen Gwynne-Vaughan, in her presidential address, takes the view that they are more probably a separate group originating among the Protista.

Few of the fungi liberate gametes; in the great majority of those possessing a sexual process this consists of the union of cœnocytic gametangia which may be similar or may differ in size and form. In most of the Oomycetes male and female organs are borne on the same plant, but *Phytophthora Faberi* and species of *Dictyuchus* are diœcious. In the Mucorales the union of similar gametangia is common, but these are often borne on separate plants, and appear only when two appropriate mycelia meet. Blakeslee, who first observed this phenomenon, designated the mycelia as (+) and (−), and described those species with (+) and (−) mycelia as heterothallic. It seems clear that the distinction is one of sex, though, in the absence of visible distinction between the mycelia, or between the gametangia which they bear, the terms male and female cannot be used.

In the higher fungi only a few diœcious species are known, with male and female organs borne on different plants: but a large number are heterothallic, two or more mycelia co-operating in the production of fruits. One of the most striking characters both of the Basidiomycetes and Ascomycetes is the tendency of the vegetative hyphæ to fuse. Branches link up neighbouring filaments, whether of the same or different origin, and germ-tubes from distinct spores flow into one another. This condition has probably a nutritive value; it raises in a special form the question of the meaning of an individual.

In a considerable number of species mycelial fusions are required before fructifications can be developed; in most of these species there are two kinds of mycelia, in some there are four, in a few there are three. In all such cases only fusions between appropriate mycelia are immediately fertile, though in several of these heterothallic forms fruits will ultimately appear in single spore culture. Most investigators have considered the difference between the mycelia as one of sex, in spite of the complete lack in many cases of sexual organs, and the difficulty occasioned by the occurrence of three or four 'sexes.'

Alternatively, it is possible to regard the difference between the fusing mycelia as nutritive even when associated with the production of fruits. This hypothesis involves a consideration of the physiological conditions affecting the formation of fruits, and of the occurrence of saltation in fungi; it is strengthened by unpublished work on one of the Ascomycetes which is to be described in detail during the meeting of the Section.

The problem is one which affects our conception of the significance of sexual reproduction in all groups of organisms, and may serve to throw light on the primitive sexual process.

Education: The Next Steps.

Dr. Cyril Norwood, president of Section L (Educational Science), refers in his address first to the growing belief in the value of education which has characterised the twentieth century in England. But, since its history has been the story of satisfying practical needs as they have arisen, English education is as a system neither logical nor complete, and there are many gaps still to be filled.

The system of dual control in elementary education means the lack of simplicity, economy, and efficiency, and it is argued that in spite of the danger of raising the 'religious' question, the proper course is to transfer the voluntary schools to the local education authorities so long as facilities of entry shall be maintained for the denominations at certain regular and definite times. Besides this administrative problem the need for rethinking the whole of education from eleven to fifteen years of age on a psychological basis is urgent, and the proposals of the Hadow Report are commended.

It is pointed out that in England now, out of 700,000 children in any one year, 300,000 are outside instruction altogether at the age of 14+, and at 15+ the number is 520,000; it is argued that this sacrifice of the children at a critical age is the cause both of unemployment and unemployability. It is necessary to develop a system of universal scope and much variety, and to carry into it that spirit which in the last thirty years has changed the character of the elementary schools, and made them no longer merely the places of mechanical instruction in the three R's, but more living centres for the training of hand, eye, and voice.

The great growth of secondary education is described: since 1904 the schools have increased from 575 to 1489, and the pupils have multiplied four times. So sudden and large an increase has developed considerable strains in the fabric of the system, which was designed to meet the needs of university and professional students. It is argued that it is no longer right to force all into this single mould, and that there should be a double system of certificates, one to be given to those who follow the old academic course, which has proved its value, and the other to be given to those who have followed a general course suited to their needs, but do not intend to carry their education beyond the secondary school. The question whether the higher work of the schools is unduly specialised is raised, and a conference of all the universities is asked for in order that they may, if possible, arrive at a common mind both as to the age of entry of their students, and the kind and standard of knowledge which they wish them to possess.

In the field of technical education it is urged that it has been too isolated, and that there is need of much fuller contact, of more knowledge and sympathy, not only between technical education and industry, but also between all forms of industry and commerce, and all forms of education.

The question is raised, What is the proper part which formal and external examination should play in the educational course? While it is allowed that the attacks on examinations are frequently unreasonable, it is argued that the proper use of external examination is as an avenue to the universities and professions, but that the case of the average boy or girl should be met in the future by the issue of a certificate that he or she has followed the full course of an efficient and recognised school. No child under fifteen years of age should in any case be examined save by his own teachers, and the common entrance examination for the public schools is held up as an example of the examination method at its worst, necessitating mechanical teaching and work in the preparatory schools, and impairing the mental development of the pupils.

The address ends with a statement of the vital importance of the work of teachers in this generation, when the country is committed to the experiment of unrestricted democracy, and everything depends on the production of a citizen body capable of discussing the true values of life.

The Live Stock Industry and its Development.

The address of Dr. J. S. Gordon, president of Section M (Agriculture), deals with the important position which live stock and live stock products occupy within the British Empire. This is shown by comparing the relative importance of crops and live stock production in several countries of the Empire. In the British Isles the decrease in tillage between 1871 and 1926 has been very striking in comparison with the maintenance of the live stock population during the same period. Arable farming has declined greatly in face of trans-oceanic competition, while live stock has been maintained in the face of almost equally serious competition from the Argentine and the New World. Price levels have ruled more heavily against crops than stock and stock products. The changes and improvements in the live stock industry during recent years have been extraordinary, especially in regard to early maturity and quality in the production of beef, mutton, and pork, in high yields of milk and butter-fat in dairy cattle, and in large egg records in poultry. These changes during recent years in beef, mutton, and pork are attributable to the demand for small joints, and the influence of pedigree sires in the development of fine quality and early maturing animals. Although the average weight of beef cattle has only decreased by 6 per cent since 1913, the most striking feature is that the reduction in age is considerable.

Great Britain has the reputation of having the finest pedigree stock in the world, and yet probably nowhere else in the British Empire is improvement in the cross-bred cattle more urgently needed. It is a strange anomaly that pure-bred stock are

exported to all parts of the Empire and to foreign countries for the improvement of the native stock, while at home cross-bred stock are in comparison so inferior to the pure-bred stock. This can be altered and improved by the increased use of pedigree sires, and in this direction the State can give considerable assistance with great advantage to itself. The State can also help by the elimination of the scrub bull, which will only be accomplished in an effective manner by legislation. The agricultural scientist can assist in this improvement along four distinct lines of research—animal nutrition, animal diseases, animal breeding, and marketing.

An extension of our knowledge of animal nutrition in connexion with the economic rationing of early maturing animals would be of considerable value to the live stock industry. The whole question of malnutrition is of fundamental importance, particularly in its relationship to health, fertility, and disease resistance. Nutrition is no longer a question of protein and energy requirements. The work in progress on mineral metabolism is opening up new lines of advance and broadening our conception of the close connexion between nutrition and disease. The need for extended research into the diseases of farm animals as the best method of protecting the live stock industry against epidemics which annually threaten it so seriously is beyond question. The problems of animal breeding are equally important. To the system of marketing live stock products pursued in Great Britain is largely due the inferior position which these products occupy on the home markets. British methods of marketing stock and stock products require a comprehensive reorganisation.

As progress is made in grading up stock by breeding methods, it is imperative that there should be corresponding developments in our knowledge of nutrition, disease resistance and elimination, and in marketing. The funds devoted to such work are quite inadequate when viewed in the light of the importance of the live stock industry, which in England and Wales alone is worth approximately £154,000,000 per annum.

If we are only prepared to attack these problems in a live and organised manner, there is a future, and a bright future, for the live stock industry.

Preservation of Scenic Beauty.

In his presidential address to the Conference of Delegates of Corresponding Societies, Dr. Vaughan Cornish points out that the great work of preserving scenic beauty in town and country calls for division of labour, and the special task of academic bodies and their learned members is to establish a sound æsthetic of scenery. For this it is necessary to discover and define the harmonies of scenery, those combinations which produce the aspects more than merely pleasing which fill the mind with joy. When these are known, it becomes possible to discriminate with certainty between the change that threatens irreparable damage and that which, although at first unpleasing, will introduce a novel beauty when the new pattern is complete.

He that aspires to be instructor or guide in matters of scenic beauty must submit himself to the discipline of contemplation. In his walks abroad he must let busy thought quiet down that the mood of receptive attention may become dominant. Then the whole being can be stirred, for the emotions aroused by scenic harmonies are not merely primitive, they result not only from physical inheritance but also from the sum of all the past action, feeling, and thought of a man's own life. It is only the jostling, obtrusive thought of the hour which must be eliminated in order to reach the contemplative state, and to all who attain this condition the harmonies of scenery bring an integration of the personality which is beyond the reach of those who neglect the correlation and synthesis of thought and feeling.

Of the practical problems relating to the scenery of cities, that of smoke abatement is still the chief. Remove the smoke-cloud, and cornice and colonnade shadowed by the sun produce their architectural effect; vegetation flourishing in park and boulevard relieves the eye and brings the fragrance of the country into the heart of the town; and the *al fresco* habit induced by clean, bright, fresh air imparts new interest and animation to the scenery of urban life.

The problems of motor traffic in relation to the amenities of village street and country road, difficult as they are of solution, have at least been clearly stated, but that of seaside planning has not received due attention. The fishing village was rightly placed to hug the shore, but the prevailing practice of developing the seaside resort with building-line close to the beach is radically wrong. There should be a broad lea in front, for a mere roadway and footpath between the houses and the beach is utterly inadequate as pleasaunce for a considerable town, and the message of the free and open ocean is lost amidst a jostling crowd.

The purely agricultural districts of Great Britain are both decorative and full of human interest, but for the development of personality it is needful that the contemplation of untouched, spontaneous Nature should come as a rhythmic variation, hence the national need for the reservation of complete landscapes of the wild. In respect of such reservations, it may be well to warn the enthusiasts of forestry that if the culminating heights of down and moor be planted with trees, their beauty as distant sky-line will be completely ruined.

In one prospect of untouched, elemental Nature our island home is pre-eminent, the view of the sea from precipitous cliffs, an image of infinity and eternity inestimable in its influence upon the loftier imaginings of the people. Without question, the time has come when no further encroachment should be permitted upon customary access to the sea cliff.

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in the irregular variations at distant stations, there must be correlation at stations close together, and it is important to determine limits of distance. By the photoelectric method this should be comparatively quick and easy.

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The work here described is discussed somewhat more fully in *Proc. Roy. Soc.* A, vol. 119, p. 11, 1928. The figures are here reproduced by kind permission of the Society.

See also on some points earlier papers—*Proc. Roy. Soc.* A, vol. 106, p. 117 (1924), and *Proc. Roy. Soc.* A, vol. 109, p. 428 (1925).

The results of these earlier papers are, however, in part superseded.

A paper on *Visual Observations of the Aurora Line in the Night Sky* appears in *Gerlands Beiträge zur Geophysik*, May 1928.

Oceanographic Observations between Greenland and North America.

By DONALD J. MATTHEWS.

THE history of the exploration of the seas between Greenland and America begins in the year 982, when Erik the Red founded on the south-west coast of Greenland the Norwegian colonies which were abandoned about the end of the fourteenth century. To oceanographers, the interest of this episode lies in a suggestion by Otto Pettersson that such voyages could not have been made in the open ships of the Norsemen unless the ice conditions had been much more favourable than they are now, and that the colonies were eventually abandoned because the climate had become more severe. The second stage in the exploration was the series of attempts to find a Northwest Passage, which came to an end with the discovery of Baffin Bay in 1616, and the third brings us down to the present time and includes the whaling voyages, the Danish voyages of discovery along the Greenland coast, and modern Arctic exploration. The reports of the ice masters contained a great store of information as to the general set of the currents and the distribution of icebergs and sea ice, but little else of oceanographical value, and in particular they throw no light on the cause of the great variation from year to year in the amount of ice which drifts southwards to the trans-Atlantic traffic lanes.

The circulation of the water is fairly simple. The East Greenland Current flows south and west to Cape Farewell, round which it turns to the north-west under the directing force of the earth's rotation and the density gradient across the coastal fringe of lighter water. It then becomes the West Greenland Current and flows northwards, probably as far as Melville Bay; according to some oceanographers, however, it does not penetrate beyond Disko Bay, and the northerly coastal current in Melville Bay is of the nature of an eddy. No east coast bergs are found on the west coast north of Julianehaab, about 100 sea miles beyond Cape Farewell; and in the Godthaab region, in about 65° N. lat., the cold current comes in contact with a warmer salter Atlantic current, in which the last of the sea ice melts. There appears to be a tendency for the current to spread westwards on the surface in these latitudes, but it carries no ice with it. Much less is any ice carried southwestwards from Cape Farewell to Newfoundland by a direct extension of the East Greenland Current, in the way shown on some of the older charts, with complete neglect of the necessary effect of the earth's rotation.

In Baffin Bay there is a northerly set on the east side in Melville Bay with many bergs, and westwards of this two great southerly drifts of heavy ice which are derived from Smith Sound, the western Sounds, and from Melville Bay, which are known as the Middle Ice and the West Ice. Between them, at the head of Baffin Bay, lies one of the most interesting features of these regions, an open space called the North Water, said never to freeze over, and generally attributed to a current of warm salt Atlantic water welling up from below. The Middle Ice and the West Ice unite at the northern entrance to Davis Strait, and as the Labrador Current flow south and east along the continental shelf of the Labrador coast as far as the Tail of the Grand Banks.

Little is known of the oceanography of these waters. The *Scotia* and the *Chance* have shown that the current on the Labrador coast is confined to the shallow water of the continental shelf, and that to the eastward of it lies warmer and salter Atlantic water in which the lines of equal density are horizontal, as if the water were at rest, at least so far as density currents are involved. This is somewhat remarkable, since there must be a continual movement northwards to compensate for the water removed on the outer edge of the Labrador Current, and in any event it is known that this water, or at least a similar water, dives under the fresher and colder surface layer in about the latitude of Cape Farewell and flows over the ridge in Davis Strait as undercurrent at a depth of 125 metres. In Disko Bay it is found at 200 metres, and at 250 metres in Melville Bay. In the north of Baffin Bay it meets the rising bottom at the entrance to Smith Sound, and is forced upwards to form the North Water and feed the Middle and West Ice. The permanent existence of such a warm layer between two colder ones necessitates a permanent northward flow from the open Atlantic.

The currents described account for the general trend of the movements of the ice but do not explain their changes. In 1906, Mecking published a discussion of the material then available from the years 1888 to 1896. According to his results, the bergs are for the most part formed in the Disko region, on the west coast of Greenland

north of Davis Strait, and are set free in the summer. If the barometric gradient is such as to set up strong east winds in this region, the bergs are blown across to the Labrador Current, which carries them southwards so as to reach the waters south of Newfoundland in the following spring and summer, with a maximum in May and nearly as many in June. If, on the other hand, the wind is weak or deviates much from east, the bergs either are held up near their birthplace or else they wander northwards to Melville Bay, where they may drift about for years before they break up or are carried over in to the south-going Middle Ice.

A favourable summer gradient in the Disko region is thus necessary for a rich berg season in the following spring, but it is not sufficient by itself. The bergs are off Labrador during the winter months, when the mean wind is parallel to the coast in a south and east direction. If there is an on-shore component in the wind the bergs may strand or be held up in the pack along the coast, so that they reach the traffic lanes late or very probably not at all. An off-shore component, on the other hand, keeps them in the strength of the current, and a rich ice season follows. The wind affects the field ice on the Labrador coast in the same way, but earlier than the bergs, and Mecking pointed out that it should be possible to make forecasts concerning the bergs from the amount and movements of the pack earlier in the year.

The officers of the U.S. Coast Guard engaged on the International Ice Patrol which was instituted after the loss of the *Titanic* in 1912, have recently repeated Mecking's work with the assistance of the Meteorological Office and the U.S. Weather Bureau, making use of a much larger number of observations. A preliminary report shows that they attach more importance to the winter barometric gradient on the coast of Labrador than to the summer gradient in the Disko region. They consider that the sea ice on the Labrador coast acts as a fender which keeps the bergs from grounding and gives rise to a rich ice year; bergs and sea ice therefore vary in the same way, but not for the reasons given by Mecking. Methods of forecasting the amount of berg ice depending upon the use of an equation into which the gradient enters, and also upon reports of field ice, have been devised and are being tested.

Lieut.-Commander E. H. Smith, of the U.S. Coast Guard, has been oceanographer of the International Ice Patrol for many years, and has worked out recently, on the lines laid down by V. Bjerknes, Helland-Hansen, and Sandstrom, a remarkable system of forecasting the drift of the bergs on the Tail of the Banks. The salinity of the water samples collected at a number of positions and depths down to 750 metres is determined on board by an electrical method, and from these and the temperatures are calculated the density and the height of the surface of the water above the layer, assumed to be at rest, at which the pressure of 750 decibars occurs and which is at a depth of nearly 750 metres. These heights are plotted on a chart, and the resulting contour lines are drawn for intervals measured in millimetres; they correspond to the isobars of a weather chart, and for all practical purposes are the stream lines which the bergs follow. This method is still under test.

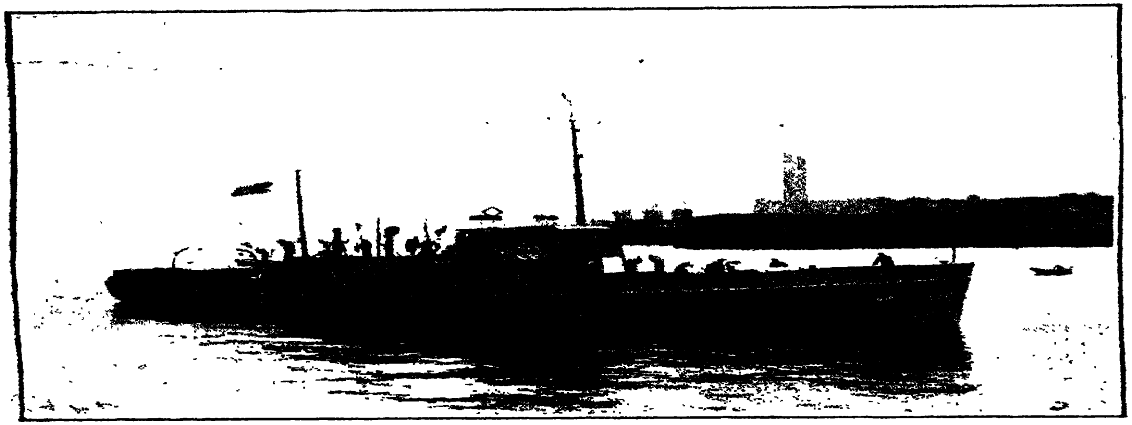

FIG. 1.—The U.S. Coastguard Patrol Ship *Marion*.

The work of the Ice Patrol is confined to the water south of Newfoundland, but now that the ice season on the traffic lanes is over for the present year, Lieut.-Commander Smith is at sea in command of the *Marion* (Fig. 1), making oceanographical observations and soundings in the region between Greenland and America south of Davis Strait, and working in close co-operation with a Danish expedition in the *Godthaab*. His ship, a coastguard patrol vessel, is 125 feet in length, has twin screws with Diesel engines, and a radius of action of 3000 miles at 10 knots. She is well equipped for oceanographical work, and carries an echo-sounding machine, the fathometer, which allows soundings to be made at short intervals without stopping the ship, and also with wire sounding gear for controls and for collecting samples of the bottom. She will be at sea for two months, during which it is hoped to cover 4000 miles on zigzag courses. Lieut.-Commander Smith has a nearly clear field for his work and should be able to make large contributions to oceanography. In particular, he should be able to obtain dynamical sections across the whole area, from which it should be possible to deduce the currents, and especially the strength of the undercurrent in Davis Strait.

Other interesting problems relate to the warm water which meets the cold current near Godthaab, the reason why the west coast is so favoured climatically in comparison with the Labrador side, and the drift of the bergs in the Disko region. Finally, there is the whole subject of the depth and geological history of the basin. The results will be awaited with keen interest. The *Marion* is equipped with a short-wave wireless outfit, and it is hoped to keep up communication with headquarters through the help of amateurs.

News and Views.

THE report of the Council of the British Association for 1927–28 refers to the meeting to be held in South Africa next year. Mr. O. J. R. Howarth, secretary of the Association, has recently visited South Africa and conferred with the authorities there, with the result that the following provisional arrangements have been made :—CAPE TOWN, July 22 – July 28–29. Inaugural meeting, July 22, at which it is proposed that the president of the South African Association should address the meeting first, and that the new president of the British Association, Sir Thomas Holland, should then be installed, and reply. Sectional meetings, mornings only, July 23–26. Evening discourse, public lectures, excursions, etc. Call at Kimberley, July 29–30. JOHANNESBURG, July 30–31–Aug. 4. Presidential Address, July 31. Sectional meetings, mornings only, July 31 August 3, and other arrangements as above. PRETORIA—Sectional transactions, etc., as appropriate in connexion with the co-operating congresses; continuing to Aug. 7. After the meetings, extended tours through the Union, to Victoria Falls, Rhodesia, Lourenço Marques, etc., as to which members will be afforded opportunity to indicate their preference.

IT is proposed that in consideration of a grant by the South African Association to the British Association of a sum not exceeding £500 and reckoned at £1 per head of the number of persons involved, the British Association should admit to membership members of the South African Association in good standing down to June 1929, entitling them to attend the meeting and receive the report if desired. From 300 to 400 members are expected under this category, and the arrangement resembles that made in 1905. An offer has been received from the Rhodes trustees, and has been gratefully accepted by the Council, to make a grant of £200 towards any further authoritative investigation at the ruins at Great Zimbabwe undertaken in connexion with the South African meeting. A generous invitation has been received from L'Association française pour l'Avancement des Sciences, and from the City of Le Havre, for members unable to take part in the South African meeting to attend that of the French Association in Le Havre, as was done in 1914.

THE British Association, like the great majority of scientific societies, has been unable to recover income tax previously remitted upon income from invested funds. The cases regarded by the Inland Revenue authorities as test cases upon the liability of societies to taxation (Geologists' Association; Midland Counties Institution of Engineers) have been decided against the societies by the Special Commissioners and in the High Court of Justice. The Council is informed that appeals against these decisions have been lodged. An article upon this subject appeared in the issue of NATURE of Aug. 25. The treasurer of the Association points out in his report that by those decisions the Association is deprived of one-fifth of the income derived from invested funds.

BENMORE and Puck's Glen, a charming region of mountain and stream at the head of Loch Fyne in Argyll, has been given by Mr. Harry George Younger of Benmore to the Forestry Commission acting on behalf of the nation, as recorded in our issue of July 21 (p. 105). It is a handsome and appropriate gift, for the former bare valley had been transformed into a forester's paradise where native and foreign trees grow in great variety and luxuriance, by a former owner, James Duncan of Benmore. Mr. Younger built upon his predecessor's foundation, with the result that Benmore seems destined to be the chief training, experimental, and demonstration area for State forestry in Scotland. Its importance is enhanced because it borders on properties already in the hands of the Forestry Commission. The Commission has decided to hold a formal ceremony at Benmore on a most appropriate occasion. On Saturday, Sept. 8, the Botanical Section of the British Association will make a special excursion to the property, and in the presence of representative botanists of this and other lands, the Right Hon. Sir Herbert Maxwell will dedicate a memorial to the late Sir Isaac Bayley Balfour, in recognition of his lifelong service to arboriculture. Puck's Glen, a mountain gorge full of beauty in itself, affords magnificent glimpses of the wonderful scenery of the district, and the finest view point is now capped by the Bayley Balfour Memorial Rest Hut, a charmingly fantastic structure designed by Sir Robert Lorimer. The hut is built of wood, every variety of timber grown on Benmore being represented in the panelling, the roof-shingles, weather-boards, and the like. Two dedicatory panels are placed within, one to Bayley Balfour and the other to commemorate James Duncan's participation in the afforestation of the area. A small brochure, containing photographs of the memorial hut and of characteristic views in the Glen, has been prepared by the committee in charge of the arrangements.

THE results of the excavations which Prof. Gordon Childe has been carrying out this summer in the Orkneys have now been made known to the public by his letter in the *Times* of Sept. 3. The site on which he has been at work on the southern shore of the Bay of Skail, parish of Sandwick, Orkney, is in many ways remarkable. It is a village consisting of a congeries of chambers or huts of dry masonry, all roughly square, with each course of the masonry projecting slightly

beyond that below as if they had once had corbelled roofs. The walls are extremely well preserved, and niches and shelves are intact. The huts opened on to streets which, curiously enough, were roofed over with stone slabs. These roofs had been used either as camping-places or kitchen middens, for they were covered with kitchen refuse. The excavators had to cut through some five feet of kitchen refuse before they reached the stone slabs. The interior of the huts showed hearths at several levels, traces of later occupation for which evidence of date was afforded by the remains of the red deer. When the original floor was reached, it showed signs of hasty evacuation and a state of indescribable filth.

PROF. CHILDE found that relics were relatively plentiful and, being for the most part of stone, in an excellent state of preservation. Pens of stone pointed to the fact that domestic animals, probably pigs, were kept there. Two finds of outstanding importance were made. One was that of two skeletons in a stone receptacle, of which the slabs were built into the wall in such a way as to form an integral part of the structure. They may well, as is suggested, be the vestiges of a foundation sacrifice. Secondly, on one of the slabs were regular marks which Prof. Childe thinks may represent a script. The culture is neolithic in character; but the occurrence of a script suggests a late date. It may be a survival, which would not be impossible in such a remote district, notwithstanding the existence of a pre-Viking iron-using settlement near by.

ARRANGEMENTS for the programme of the Folklore Congress, to be held in London on Sept. 19–25 in connexion with the jubilee year of the Folklore Society, are now approaching completion. The Congress will open at the rooms of the Society of Antiquaries at 4 P.M. on Wednesday, Sept. 19, when a reception of foreign delegates and members will be held. In the evening, by kind invitation of Dr. Henry S. Wellcome, a conversazione will be held at the Wellcome Historical Medical Museum. Thursday will be taken up by papers, the presidential address at 10 A.M. being followed by communications by Prof. Sayce on Egyptian folklore, Dr. G. Roheim, Prof. Starr on Filipino folklore, and others. In the evening a lecture, illustrated by a cinematograph film, on the folk-dances and ceremonies of eastern Europe, will be given by Prof. Pospišic of Brno in the lecture theatre of the Imperial Institute. The papers on Friday include Prof. Rose on mummers' plays in Attica, Prof. R. M. Dawkins on the study of folklore in modern Greece, Mrs. Hasluck on the games of the Turks, and Prof. Schütte on bull-worship among the Kimbri. On Saturday excursions will be made to Oxford and Cambridge. The papers on Monday cover Celtic folklore, and on Tuesday Dr. Ernest Jones deals with psycho-analysis and folklore, and Prof. Elliot Smith with a survival in British folklore from the Rig Veda. The membership fee for the Congress is 10*s*. 6*d*. Full particulars may be obtained from Mr. Allan Gomme, Hon. Sec. Folklore Congress, c/o the Royal Anthropological Institute, 52 Upper Bedford Place, London, W.C.1.

AN interesting programme of excavation in Iraq is announced for the coming autumn. Not only is the number of expeditions increased from five to eight, but also both France and Germany resume their pre-War activities. Germany, indeed, has already sent workers to Iraq who have received from the Government a share of the finds made before the War, but this year two parties will be actively engaged in excavation: one under Dr. Julius Jordan will dig at Erech, north of Ur, and the Deutsche Orient-Gesellschaft, which was working at Babylon before the War, will now dig at Ctesiphon on the Tigris. Under the auspices of Le Louvre, Père Legrain is resuming the French excavation of Sumerian culture at Tel-lo. Two American expeditions will be at work: one under Prof. Waterman, of the University of Michigan, will work at Tel-Omar in Ctesiphon, and the joint expedition of Harvard University and the American School of Oriental Research, now in its third year of excavation, at Tarkalan, near Kirkuk. The excavations at Ur of the British Museum and the University of Pennsylvania, and the Oxford University and Field Museum excavations at Kish, will, of course, be resumed as usual.

THE use of ether and certain other chemical vapours for the purpose of shortening the rest period of plants has been an important factor of success in the florist's business, enabling him to meet the demand for blooming specimens at Christmas. A good many different chemicals have been tried; quite recently two have been found especially valuable, particularly for inducing early germination of potato tubers. A paper by F. E. Denny, read at the annual meeting of the Society of Chemical Industry in New York and published in the *Transactions* of the Society, describes the use of ethylene chlorhydrin, a chemical which is now made in quantity at a reasonable cost in the United States and has also recently become available in Great Britain. The potatoes are either cut and dipped into a weak solution of the chlorhydrin and kept in a closed container for twenty-four hours before planting or, on the large scale, whole tubers are exposed to the vapours in a suitable tight room for twenty-four to forty-eight hours. These are stored for a week, at which time sprouting begins, cut, and planted.

THE gain in time induced by the treatment with chlorhydrin was at least one month; some varieties of potato may be treated as soon as lifted. The application of this in industry may enable two crops of potatoes to be grown in one year in the southern States of America, and facilitates the planting of the potato crop in Bermuda, Cuba, Florida, and similar countries, which is done in the autumn, when normally it is difficult to obtain tubers that will sprout. From the point of view of cost and safety to workmen applying it, ease of application and uniformity of result, the use of chlorhydrin leaves little to be desired. The explanation of the phenomenon is well known: as was pointed out by Farmer and Waller in 1898 and by the Armstrongs in 1910, many chemical stimulants check the protoplasmic currents in the plant and cause certain hydrolytic or downgrade changes, thereby releasing the previously insoluble intracellular enzymes

without rendering them inactive. In consequence growth begins.

THERE seems to be feverish activity in the United States at present as to who will broadcast the first news radiovision service. We hear from Science Service, Washington, that radiovision has arrived, and a list is given of eight radiovision stations, with technical details of the emission. For example, 3XK, Washington, will send out 'radiomovies' on Monday, Wednesday, and Friday between 8 and 9 p.m., Eastern standard time. The frequency of the radio waves will be 6420 kilocycles (46·7 metres). Forty-eight lines of light are used to produce the pictures, and there are fifteen pictures per second. The General Electric Company of Schenectady, WGY, sends out twenty pictures per second, the frequency of the radio waves being 790 k.c. (380 metres), but there are only 24 lines per picture. This Company broadcasts from 1.30 to 2 p.m., Eastern time, on Tuesday, Thursday, and Friday. On Tuesday also it broadcasts from 11.30 to 12 midnight, and on Sunday from 10.15 to 10.30 p.m. On Sunday and Friday it also sends out 13660 k.c. (21·96 metres) waves at the same time as the 790 k.c. waves, and on Thursday and Tuesday at 9550 k.c. The Westinghouse Co.'s Station at Pittsburgh, Pa., and several other stations, are sending out irregular broadcasts for experimental purposes. To suggest that the radiovision pictures are anything like so good as sound radio broadcasting was in 1921, is scarcely fair to the many able engineers engaged on the problem and discounts the advances they will doubtless make in the future. The pictures are still very crude, and no doubt many difficulties have still to be overcome before any radiovision service can be considered satisfactory, but every encouragement should be given to those who are devising even slight improvements of existing apparatus or methods.

THE nineteenth meeting of the German Society of Naturalists and Physicians, a counterpart of the British Association, is to be held in Hamburg on Sept. 15–22. The invitation programme now available may be obtained from the secretaries, Hamburg 13, Universitäts-Gebäude; tickets cost 25 RM. or less; bedrooms 3·50 RM. or more. The more important addresses are timed for 9 A.M. or 3 P.M., evening hours being reserved for festivities. Lectures begin with Senator F. H. Witthoefft on world economics and national food supply, followed by Prof. Walden on the importance of Wöhler's synthesis of urea. The medical group is to deal with the onset and disappearance of epidemics and the influence of psychic factors on the sympathetic nervous system. On Tuesday, Sept. 18, the lectures are on the blood-group problem, photochemistry of iron carbonyl compounds, combatting cattle plagues, Naegeli's micellar theory, and the importance of isostasy in the shaping of the earth's surface. On Wednesday, Sept. 19, general lectures are continued—scientific results of the voyage of the *Meteor*, short-wave telegraphy, chemistry of hormones and the female sexual hormone. Popular evening lectures will deal with the ultramicroscopy of the molecule by the use of Röntgen rays, the world and environment, health and housekeeping, colour and scent of flowers, communities of men and bees. The detailed programmes of thirty-five sections are cross referenced with invitations and entangled with the meetings of about as many separate but allied societies. There will be cinema shows, an exhibition, zoological gardens, and an institute for tropical diseases to visit. The meeting ends with a visit to Kiel (milk research institute and model dairy), and alternative excursions to Cuxhaven, Heligoland, Westerland, Wyk, Borkum, Nordeney, Lübeck, Schwerin, Lüneburg, Denmark, Norway, and Sweden.

SIR JOHN RUSSELL finished a very strenuous tour in Australia at the end of July and then sailed for New Zealand. His lectures in the capital cities aroused considerable interest amongst agriculturists. In the intervals he travelled by train, aeroplane, and motor over long distances, and was enabled through the co-operation of universities, State departments of agriculture, and the Council for Scientific and Industrial Research to make a close study of many features of Australian agriculture. Chief attention was given to problems arising in the irrigation areas of South Australia, Victoria, and New South Wales, and Sir John was able to examine numbers of typical soil profiles. Difficulties associated with sodium clays, impermeable clay-pans, the rise of salt, the duty of water, and so forth, are being acutely felt in these areas, and the need for close study of them is becoming more imperative each year. Steady progress in soils work is being made under Prof. J. A. Prescott as the result of a co-operative arrangement between the Council for Scientific and Industrial Research and the Waite Institute (University of Adelaide) and it is anticipated that close and effective association with the proposed Soils Bureau at Rothamsted will be rendered possible as the result of this visit. The proposal to establish a new irrigation research station in the Murray watershed is in abeyance pending the report of the Irrigation Sub-Committee of the Committee of Civil Research, of which Sir John Russell is a member.

AN earthquake of moderate intensity was recorded at Kew Observatory at 6 hr. 18 min. 39 sec. G.M.T. on Sept. 1. The epicentre was about 3900 miles away, but the initial impulse was too small to give any indication of the bearing.

THE annual report for 1927 of the National Institute for Research in Dairying, University of Reading, recently issued, contains an account of the Institute and of the research work that has been carried out, as well as of some of the problems awaiting study were the necessary funds available.

THE July issue of the *British Journal of Physiological Optics* completes the second volume of the journal. It contains the concluding part of the retranslation and republication of the "Atlas of Opthalmoscopy" of Prof. Haab of Zurich, which has been carried out by the editor of the journal, Mr. W. B. Barker. The numerous coloured plates of the Atlas reflect great credit on the printers.

The discussion on colour vision is continued by a paper by Mr. D. C. Henry, who considers that the trichromatic theory is the most satisfactory one in the field, and that when it is supplemented by some form of photo-chemical theory of the retinal mechanism, it may provide explanations of fatigue and contrast phenomena which at present it cannot do.

MESSRS. Watts and Co. announce the early publication in their Shilling Forum Series of "Craftsmanship and Science"—Sir William Bragg's presidential address to the British Association; also of Sir Arthur Keith's Ludwig Mond lecture on "Darwinism and what it implies."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A resident lecturer (man) in rural science and gardening, with mathematics as second subject, at the Bangor Normal College—The Principal, Normal College, Bangor, North Wales (Sept. 14). A warden of the Moulton Farm Institute and assistant county agricultural organiser for Northamptonshire—The Secretary for Education, County Education Offices, Northampton (Sept. 14). Junior assistants at the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Sept. 18). A pathologist at the Miller General Hospital for South-east London—The Secretary, Miller General Hospital for South-east London, Greenwich Road, S.E.10 (Sept. 20). An assistant pathological chemist at St. Mary's Hospital—The Secretary, St. Mary's Hospital, W.2 (Sept. 24). A scientific officer under the Directorate of Scientific Research of the Air Ministry, primarily for research at the Royal Aircraft Establishment in connexion with aircraft power units—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Sept. 25). A Milroy lecturer on State medicine and public health for 1930—The Registrar, Royal College of Physicians, Pall Mall East (Sept. 26). An instructor at the Government Technical School, Makerere, Uganda, capable of giving instruction in carpentry and joinery, fitting and turning, blacksmithing and tinsmithing, etc.—C. A. (N). The Secretary, Board of Education, Whitehall, S.W.1; *for Scottish candidates*—(N), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Sept. 30). A principal and professor of medicine, and a professor of pathology and bacteriology, at the Veterinary College, Patna—The Secretary to the High Commissioner for India (General Department), 42 Grosvenor Gardens, S.W.1 (Oct. 15). An irrigation engineer under the Government of Ceylon—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/732). A headship of the Junior Technical School for Boys of the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. Two temporary engineering assistants under the Air Ministry, capable of preparing detail drawings, reinforced concrete work and steel structures—The Secretary, Air Ministry, Adastral House, Kingsway, W.C.2. A museum assistant at the Norwich Castle Museum—The Curator, Castle Museum, Norwich. An entomologist at the Indian Lac Research Institute, Ranchi, Bihar and Orissa, for research work on the bionomics of *lacchardia lacca*—"India," c/o Richardson and Co., 26 King Street, St. James's, S.W.1.

Our Astronomical Column.

A NEW STAR CATALOGUE FROM OBSERVATIONS WITH THE GREENWICH ALTAZIMUTH.—The present Greenwich altazimuth was erected in 1897, taking the place of Airy's smaller instrument which had been in use for half a century. It was used for observing the moon in the first and last quarters of each lunation, at which periods meridian observations are untrustworthy. For the rest of the time it was used in the meridian as a second transit circle. When Brown's new tables of the moon were introduced into the almanac in 1923 there was such an improvement in the representation of all the short-period terms in its motion that it was considered that meridian observations of it would suffice for the future. The altazimuth was then placed in the Prime Vertical for the observation of fundamental stars, and a catalogue of these, based on observations extending from June 1923 to January 1927 has just been issued; it contains all stars of magnitude 5·4 and brighter, the declination of which lies between N. 11° 40′ and N. 50°, their number being 601. Observations were made in azimuth only; the declination, which is found with greater accuracy than the right ascension, depends on the interval between the east and west transit of each star; refraction is not directly introduced, and the results form a useful check on meridian observations.

The results show that the declinations of Boss in this zone need to be increased by 0·45″, this correction being 0·02″ less than that of Eichelberger's new fundamental catalogue, and 0·27″ greater than that of the First Greenwich Catalogue for 1925 (observed with the transit circle). It is generally agreed that Boss's proper motions in declination have appreciable systematic errors, due probably to imperfections in the older catalogues employed by him; small as the corrections are, they are large enough to have some effect in problems concerning the structure and motions of the stellar system.

THE MELBOURNE ASTROGRAPHIC CATALOGUE.—Melbourne Observatory undertook the photography of the most southern zone of the Astrographic Catalogue extending from south declination 64° to the south pole. The printing of the catalogue has been greatly delayed by shortage of funds, but two volumes have now been published. Vol. 1, which has just come to hand, contains the measures of the plates, the centres of which are in declinations −67° and −68°. The x and y co-ordinates of each star are given to the third decimal of a minute of arc, also the measured diameters, and, in the case of C.P.D. stars, the reference number and magnitude given in that catalogue. The stars used as reference stars are in heavier type: these were measured twice. The usual provisional constants are given for reducing the rectangular co-ordinates to right ascension and declination.

Vol. 2 contains 291 pages: a full page contains 240 stars, but as many pages are incompletely filled, the average per page is probably about 200; but the stars in the volume are not all different, since those between −67° and −68° occur twice over, owing to the overlap of zones.

Research Items.

Educational Status and Fecundity.—There is a widespread belief that a correlation exists between education and sterility, and this belief has had some support from statistics gathered in America and dealing largely with college alumni. It is important, therefore, that due weight should be given to analyses which give another aspect to the relationship between education and fecundity. In the *Journal of Heredity* (vol. 19, No. 7, 1928) N. J. Butt and Lowry Nelson discuss in this connexion data obtained by the survey method from the homes in two Utah communities, one with a population slightly more than 2000, the other slightly more than 3000. In both, agriculture is the basic occupation, although all the chief occupational divisions as used by the United States Census are represented. Comparison was made of the families of parents with no education, with various grades of elementary and high school education, and with college education. The authors realise that the data are not comprehensive enough to warrant dogmatic statements, but they consider that their method should bear at least as much weight as statistics gathered from highly selected groups. Their results indicate that the families in Utah, men and women, who have had higher education, are not committing race suicide. The correlation secured (– 0·09) shows that education has very little influence on the size of the families, which average about 5 children born, of which more than 4·5 survive until after the parents are past the child-bearing age.

The Gibraltar Skull.—Anthropologists and others interested in the early history of man now have an opportunity to study in detail and at their leisure the evidence relating to the new Gibraltar skull discovered by Miss Garrod two years ago at the Devil's Tower. A full report on this relic of Neanderthal man appears in the recent issue of the *Journal of the Royal Anthropological Institute* (Vol. 58, Pt. 1), and may also be obtained separately. In addition to the very full and detailed account of the discovery and of the archæology and geology of the cave by Miss Garrod herself, the report contains the results of the examination of the specimen itself and of the attendant conditions and associated finds by various specialists. It is, of course, generally agreed that the skull is that of a child, probably male, of about five years old. Mr. L. H. Dudley Buxton, in the course of his anatomical report, compares it with the skulls of other immature Neanderthal specimens, as well as the modern child. Prof. Elliot Smith's description of the endocranial cast brings out certain differences between it and those other children of Neanderthal age, but regards these differences as variations within the type. Miss Dorothea M. Bate deals with the very interesting series of animal remains. In addition there are reports on the sands by Mr. R. C. Spiller, on fossil voles by Mr. Martin A. C. Hinton, and on fossil mollusca by Paul Fischer. Even a captious critic must agree that the collaborators have used every effort to cover all aspects of the evidence which a reasonable degree of foresight may regard as likely to be of value to the future historian of man.

The Outrigger Canoe.—In *Man* for August, Mr. J. Hornell describes and illustrates some South American balanced canoes which appear to exhibit a stage in the invention of the outrigger. While lying off the coast of Gorgona, an island in the Pacific off the coast of Colombia, in 1927, his ship was visited by a number of dugout canoes from the mainland. These canoes were graceful dugouts with terminal platforms fore and aft, and with rounded bottoms without vestige of a keel. The dimensions varied considerably, especially in length. A medium size was 18½ ft. over all. Paddles were used for steering and propulsion, but some of the canoes were fitted with a sail, the mast passing through a hole in a board lashed athwart the gunwales well forward of amidships. The characteristic feature, however, was the outrigger balance fittings. These were fitted to boats with a low freeboard and consisted of a log of the extremely buoyant *balsa* wood, approximately one-half of the total length of the canoe. The log was lashed to one side of the dugout by cords close to the fore and aft ends, the lashing passing through a hole bored in the side of the boat. In the centre it was fastened, not to the side of the canoe, but to a short projecting pole, with a piece of wood inserted between it and the pole to keep it depressed at the proper depth in the water. Afterwards, in the course of a trip inland, it was found that these canoes were one of several types, of which the final stage was a double outrigger. In one type the logs were tied in true outrigger fashion to stout outrigger booms laid athwart the hull, while in another type, a small local coaster, the dugout had superimposed upon it built-up strakes of one, two, or three planks. Although not previously recorded off the coast of Colombia, similar canoes were noticed early in the last century in Chile. As regards their origin, apart from independent invention and in view of the unlikelihood of a Polynesian source, it is probable that they were introduced by Spaniards from Manila, where a similar balanced canoe has been recorded.

Asiatic Birds in Alaska.—The proximity of north-western America to the north-eastern coast of Asia and the probability that in earlier days the relationship of the two continents was still closer, suggests that there may be a more or less regular migration of birds from one side of the narrow sea to the other. It is known that certain Asiatic birds habitually cross Bering Sea, and Harry S. Swarth now adds a few more to the Asiatic forms which have been found in Alaska (*Proc. Calif. Acad. Sci.*, vol. 17, July 1928). These include the Japanese pipit (*Anthus spinoletta japonicus*) a former American identification of this race having proved to be erroneous; Middendorff's grasshopper warbler (*Locustella ochotensis*), and a Siberian hedge-sparrow (*Prunella montanella*), the former belonging to a genus new to North America and the latter to a family (Prunellidæ) hitherto unrecorded from that continent.

Sex Studies on Schistosoma.—A. E. Severinghaus (*Quart. Jour. Micr. Sci.*, vol. 71, p. 653-702; April 1928) records observations on the stages in the life cycle of *Schistosoma japonicum*. The adults are dimorphic, but no dimorphism is apparent in the miracidium, primary and secondary sporocyst, and cercaria. The hamster was the mammalian host employed. The incidence of infection of the snails (*Oncomelania*) with the miracidia of *S. japonicum* in the Soochow region was found to be about two per cent, and owing to this low incidence it was found possible to plan mammalian infections by cercariæ from a single snail, and to be reasonably sure that practically all such snails would have been infected with a single miracidium. Exactly half of the snails harboured cercariæ which produced female flukes, while the other half produced male flukes. All the flukes recovered from the mammals infected by cercariæ from one snail were of the same sex. Male flukes alone develop in the mammal normally as regards size, form, and the production of mature

germ cells, but if female flukes develop in the mammal in the absence of males they reach only one-fifth the normal length and the reproductive organs fail to develop with the exception of a blind tube (the uterus) and an aggregate of germ cells resembling early oogonia. It is suggested that the male produces hormones without which the female will not develop. New points in the anatomy of the reproductive system in both sexes are noted. The male is heterozygous; one half of the spermatids receive eight chromosomes and the other half six. There are two X-chromosomes, and sex is determined in the fertilised egg. The oogonial cells have 16 chromosomes (diploid), and though the maturation stages were not observed, there is little doubt that the female is homozygous and that the haploid number in each egg is eight. The life cycle exhibits the interesting condition that male-determined individuals produce parthenogenetic eggs at one stage and spermatozoa at another.

INDIAN TERTIARY MOLLUSCA.—An appendix to Cossmann and Pissarro's "Mollusca of the Ranikot Series" (noticed in NATURE, Aug. 20, 1927, p. 275) has now been published by the Geological Survey of India (*Pal. Ind.*, New Series, vol. 10, No. 4). It was the work of the late E. W. Vredenburg and has been edited with notes by Dr. G. de P. Cotter. The author discusses the types of the specimens described by d'Archiac and Haime in their "Description" (1853–54) now preserved in the Natural History Museum at South Kensington, of which, unfortunately, the exact localities cannot now be ascertained from want of record or other reason. Some of the original diagnoses have had to be revised, while some new species from more lately obtained material are added. The memoir extends to 75 pages and there are 9 plates that are excellently reproduced from photographs by the Survey itself.

BUFUMBIRA VOLCANIC ROCKS.—The annual report of the Geological Survey of Uganda for 1927 contains a preliminary account by Mr. W. C. Simmons of the volcanic rocks of that part of the Bufumbira area which lies in the extreme south-west corner of Uganda. The region was geologically explored by Mr. Combe during 1925 and 1926. Of the three large volcanoes on the border, Sabinio is the oldest; its older lavas are basaltic or andesitic, while the later flows consist of olivine-basalts and leucite-basanites. These two rock-types also make up many of the investigated flows of Muhavura and Mgahinga. In some of the rocks of the latter, which is the youngest of the three, radiating groups of plagioclase laths occur giving a very characteristic appearance to the lavas. Numerous small craters are scattered over the country to the north, between the great volcanoes and Lake Mutanda. Their lavas range in composition from basalt or trachy-basalt to leucite-bearing types, some of which contain conspicuous biotite. It is noteworthy that felspar-free rocks are not restricted to the area outside Uganda to the extent that was thought likely by Finckh, but so far the variation in rock-types found in Uganda has a narrower range than that recognised by Finckh in his work on the collections made by the Mecklenburg expedition of 1907–8. Nevertheless, the Bufumbira volcanic field is evidently one of the world's most extensive areas of leucite-bearing rocks.

THE THEORY OF FERROMAGNETISM.—An important advance in magnetic theory has been made by W. Heisenberg, in a paper in the *Zeitschrift für Physik* of July 16, which deals with the nature of Weiss's intermolecular forces. The use of these has always been unsatisfactory from the fact whilst they accounted for ferromagnetism formally, it was impossible to refer them specifically to electric or magnetic interactions between the magnetic molecules. In the present analysis they are derived from a quantum resonance phenomenon between electrons moving in different places with otherwise equivalent paths, a procedure which has already proved useful in other connexions. The new theory is to some extent approximate both in its assumptions and development, but it leads to equations for the magnetic moment which are identical in their main features with those of Weiss, and has the additional merit of predicting two further conditions which must be satisfied for ferromagnetism to occur. One is that the space-lattice must be such that each atom has at least eight neighbours, and the other is that the total quantum number of the electrons responsible for the magnetism must not be less than three, both conditions being satisfied by iron, cobalt, and nickel, although not to the exclusion of other substances. The author proposes to extend the theory to the case of a more complicated atomic model.

THE UNIMETER.—In the *Chemiker-Zeitung* of June 20, Messrs. Bloch and Frühling describe a new instrument, the unimeter, which is designed for the rapid examination of the optical properties of materials of most diverse types. The instrument is likely to prove extremely useful in laboratories and factories, since transparent, translucent, and opaque objects can all be examined with equal ease and there is usually no necessity to detach samples for the purpose. It can be used for the examination of such objects as paper, metals, coloured glass, solutions, powders, gelatine, textiles, painted surfaces, etc., or for the comparison of the intensities of light from different sources. The unimeter, which is manufactured by the firm Franz Schmidt und Haensch of Berlin, is mounted like a microscope, its essential feature being a polarisation-photometer. The two halves of the circular field consist of the object under examination and a comparison-plate of dull milk-glass respectively. By rotating the photometer about its axis the dividing line between the two halves vanishes when the latter are equally illuminated. The eyepiece carries a rotating diaphragm, which is also fitted with three coloured glasses for use in examining coloured objects. The necessary calculations are greatly simplified by the attachment to the graduated circle of a scale showing the squares of the tangents of angles of rotation. Both daylight and artificial light can be employed, and various accessories can be screwed into position if desired for the purpose of widening the range of application of the instrument.

MAGNETOSTRICTION OSCILLATORS.—In the *Proceedings of the American Academy of Arts and Sciences* for April 1928, Prof. G. W. Pierce has published an important paper on 'magnetostriction' oscillators. He describes a newly discovered method of using magnetostriction to produce and to control the frequencies of electrical and mechanical oscillations ranging from a few hundred to several hundred thousand cycles per second. The method is based on the interaction of the mechanical vibrations of a magnetostrictive rod and the oscillations of current in an electric circuit. By a phenomenon called magnetostriction the oscillating electric currents cause the rod to vibrate longitudinally and the vibrations of the rod react on the electric circuit maintaining the frequency constant. The constancy of frequency obtained compares favourably with that obtained by using the piezo-electric oscillator. The construction and adjustment of the

magnetostriction vibrators is so simple that large numbers of standards of frequency can be made at little cost. In particular these new oscillators will be most useful for the range of frequencies below twenty-five thousand cycles per second, for at these low ranges crystal control is impracticable owing to the prohibitive cost of sufficiently large crystal vibrators. For frequencies between twenty-five thousand and three hundred thousand cycles per second the magnetostriction oscillators and the crystal oscillators will have a common field of usefulness. For higher frequencies the present make of magnetostriction oscillators do not work well, although they function up to two million cycles per second. It was observed that a rod of nickel when magnetised shortened by about one millionth of its length for a magnetising field of one gauss. When, however, it is magnetised by a force that increases and decreases in an oscillatory manner at a period resonant with its free mechanical oscillation, the shortening and lengthening may be more than a hundred times as great. Methods of calibrating these new oscillators for use as wave-metres are given. Very interesting data are also given on the velocity of sound in various metallic alloys.

THE EFFECT OF DRYING ON THE SYSTEM NITROGEN PEROXIDE - NITRIC OXIDE - OXYGEN.—The influence of intensive drying on the reaction between nitric oxide and oxygen was studied some years ago by Baker, who found that the dry gases did not combine. Later workers have obtained different results, and a further investigation carried out by J. W. Smith is described in the *Journal of the Chemical Society* for July. It was found that when nitrogen peroxide is heated with phosphoric oxide it dissociates to a greater extent than the moist gas, and the nitric oxide and oxygen do not recombine on cooling. The nitric oxide also decomposes into its elements at about 300° more readily than in the presence of moisture, but this reaction may be catalysed by the large surface of the phosphorus pentoxide. The formation of an addition compound between nitrogen peroxide and phosphorus pentoxide above 200°, as observed by Hartung, was also noticed. Nitrogen peroxide after intensive drying at the ordinary temperature only decomposed slightly even at 550°, but if heated to 620° and then cooled, it behaved normally. This effect may be due to partial decomposition of the glass surface at the higher temperature. Polymerisation of nitrogen peroxide to the tetroxide occurs less readily when the gas is dry.

PREPARATION AND PROPERTIES OF SELENOPHEN.—Although a few of its complex derivatives have been described, selenophen, the selenium analogue of thiophen, has apparently remained unknown. Foa (1909) claimed to have obtained it in small quantities, but his product had properties very different from those of the selenophen now isolated by H. V. A. Briscoe and J. B. Peel. Their method of preparation and many of the properties of this interesting substance are described in the *Journal of the Chemical Society* for July. Selenophen was obtained by passing acetylene over selenium heated to about 400° in a silica tube and condensing the reaction products in a cooled receiver. Several hydrocarbons were produced, but much of the brown oil formed consisted of selenophen, which was purified by careful fractionation. In the pure state it is a colourless, highly refractive liquid, freezing at about −38° and having a slight odour. Molecular weight determinations showed that it is unassociated. Chemically, selenophen resembles thiophen in being inactive and very stable. It is not reduced by ordinary reducing agents and yields no methiodide even when heated with methyl iodide at 160° for twenty-four hours. At the boiling-point it readily dissolves sulphur. Treatment with bromine or chlorine in carbon disulphide yielded the tetrabromo or tetrachloro derivative, but the corresponding iodine compound could not be isolated.

A THERMIONIC VOLTMETER.—It is well known that in general, when the electric stress between two electrodes in air attains a definite value, a spark will ensue or brush discharges will begin. This limiting value of the stress depends on the magnitude and shape of the electrodes. If alternating pressures be employed, then in computing the electric stress the peak value of the voltage and not the voltmeter reading has to be taken. In the August number of the *Journal of the Institution of Electrical Engineers*, E. B. Moullin describes a thermionic voltmeter which can measure both the peak and the mean value of an alternating voltage. The dial has two scales corresponding to peak and mean values respectively, and a change-over switch converts the voltmeter from one reading to the other. The peak value is measured by the mean grid current of a cumulative grid rectifier. It is shown by experiment that the mean grid potential is practically proportional to the peak value, no matter what the wave shape may be. The accuracy of the measurements is about the same as that obtained from oscillograms. The mean value measurement is made by omitting the grid condenser. The author discusses the accuracy of the method analytically and gives experimental results in support of it. The use of the voltmeter is illustrated by giving curves which show the distortion produced by a four-stage thermionic amplifier.

A 500 KV. TESTING TRANSFORMER.—The great advances that have been made in high tension technique during the last few years have led to continually increasing high pressure tests being specified for insulating materials. A 500 kilovolt testing plant which has been installed by the A.E.G. (Allgemeine Elektricitäts Gesellschaft) at the Enfield Cable Works, Brimsdown, is described in *AEG Progress* for August. Unlike other firms, the A.E.G. produces the high pressure by a single transformer erected in a plain boiler plate tank filled with oil. This tank can be earthed, and so there is little danger to the operator. In view of the large charging current taken by the cables during test, it was necessary to have a large continuous output. The transformer can supply at 450 kv. single phase or 260 kv. three phase continuously. The maximum pressure is only to be applied for five minutes. The spark gap is between two spheres each of 75 cm. diameter placed horizontally. The length of the spark gap is adjusted electrically by means of a motor driving a worm shaft. The maximum distance apart of the two spheres is 50 cm. and it takes four minutes before the spheres touch one another. The exact distance between the spheres is read by both mechanical and electrical indicating devices. The former is in the shape of a clock dial which can be read from a considerable distance. The voltage can also be read by means of an electrostatic voltmeter shunting the two condenser plates which are nearest the earth of a chain of condenser plates. Very elaborate safety devices and interlocks are employed. The test generator can only be excited after all the doors of the wire netting enclosure are closed. A number of red lamps are arranged round the enclosure and automatically light up when the main switch is closed. It is stated that the set is not required simply for practical purposes but also for impressing visitors and customers with the thoroughness of the methods of testing adopted.

Universities in the United States of America.

INFORMATION about higher education and research in the United States is available in great, to the uninitiated, indeed, in embarrassing abundance. Besides the 'catalogs' and reports of a thousand colleges, universities, and professional schools, there are the excellent statistical summaries and surveys of the Bureau of Education, a plentiful stream of articles in American periodicals, reports of investigations carried out under the direction of great educational associations and foundations such as the Carnegie Foundation for the Advancement of Teaching, and records of impressions of visitors from Europe. The conceptions current in Great Britain owe their origin largely to the last-mentioned source and, perhaps not less, to unpublished impressions of other visitors to America, to contact with American visitors to Europe, including Rhodes scholars, and to references in popular fiction. Anyone desiring to apply to conceptions thus formed the test of a purely objective, well-authenticated, comprehensive, and up-to-date survey could not do better than study the handbook [1] recently issued by the American Council on Education.

This volume gives, first, an admirably lucid account of the organisation of education in the United States and the character and relations of college, university, professional school, and graduate school of arts and sciences, and, secondly, particulars indicating the general character and resources of each of the 398 universities and colleges accredited by the five great standardising bodies [2] which, in the absence of a central governmental authority, provide for the development of co-operation among these institutions and between them and the schools. These bodies have all adopted and applied standards formulated by the American Council on Education which was constituted by the leading educational associations and universities and colleges in 1918.

The American 'college' stands between the British secondary school and university, offering a general education during four years and conferring a bachelor's degree. Its first two years are comparable with the last two of a European *lycée* or *gymnasium*, and its last two with the first two of the French or German university. The 'university' comprises "a college or colleges of Arts, Literature, and Science—historically the first part of the American university to come into existence—and professional colleges or schools of Law, Medicine, Theology, etc., and, especially, a graduate school of Arts, Literature, and Science."

For admission to one of the 'accredited' lists, a college has to fulfil a number of minimum requirements, among which are: an adequate staff (for example, for a college of 100 students, in a single curriculum at least eight full-time heads of departments); a moderate 'teaching load,' normally not more than 16 hours a week for an instructor or classes (exclusive of lectures) of more than 30 students; annual operating income, exclusive of payment of interest, annuities, etc., of at least 50,000 dollars, of which not less than 25,000 dollars should be derived from stable sources, other than students, preferably from permanent endowments; a library of at least 8000 volumes, exclusive of public documents. No college is accredited until it has been inspected and reported upon by agents regularly appointed by the accrediting organisation.

Co-education prevails in the west; separate colleges for women exist particularly in New England and the Atlantic States, north and south. The organisation and influence of men and women who have been students together are extraordinarily effective in America. Their secretaries have become so numerous and energetic that since 1913 they have had their own association, which has published, in addition to reports of their conferences, a "Manual of Alumni Work." A statistical study of campaigns conducted recently by sixty-eight institutions for raising funds shows that of a total sum of 150 million dollars, nearly half was obtained from alumni. Their influence has been felt not only in financial campaigns but also in matters of educational policy, and they show an increasing willingness to co-operate with employment bureaux and appointment offices.

The resources of higher education in America have expanded rapidly since the War. The latest statistics of the Bureau of Education show that between 1920 and 1926 the total annual receipts of colleges, universities, and professional schools (numbering 975 in 1926) increased from 240 to 480 million dollars, the money value of their buildings and equipment in almost equal proportion, and the number of professors and instructors from 42,882 to 62,224. So great, however, has been the simultaneous expansion of the demand for admission to these institutions that their resources have been overtaxed and they have been driven to adopt protective measures against the danger of being swamped by excessive numbers. They have imposed new and stricter conditions of admission, designed to ensure the selection of those best qualified to carry their studies to a successful issue, and there has been much discussion of fundamental questions as to the aims and purposes of higher education and what are the types of student best fitted, from the point of view of the interests of the community, for admission to its benefits.

The overcrowding with which the colleges have been afflicted has not been without compensating benefits. Whereas formerly colleges competed injuriously one with another for students, and there was excessive emphasis on externals—buildings and equipment—they are now in a position to insist on higher standards of qualification for admission, and emphasise quality rather than mere numbers. In some States the State university is required to accept any applicant for admission who has obtained a leaving certificate from the principal of any accredited high school. In more cases, however, the college requires the completion of specified work in English (3 units), foreign language (3), mathematics (2), history (1), science (1), and many admit only those students who ranked in the first seventh or first quarter of their class at the close of their school course.

Nor is this new emphasis on the quality of the student confined to the testing of his fitness for admission. The responsibility of the college for developing the individual student is increasingly recognised, and elaborate records are prepared both at entrance and afterwards for use by professors and future employers. In 1927 the American Council on Education received a grant of 20,000 dollars a year for the development of 'personnel procedure'—a term signifying the various efforts by which it is sought to bring the college into closer individual touch with its students. Many of these efforts are directed

[1] "American Universities and Colleges." Edited by David Alan Robertson. Pp. xii+884. (New York and London: Charles Scribner's Sons, 1928.) 12*s*. 6*d*. net.

[2] Association of American Universities, North Central Association of Colleges and Secondary Schools, Association of Colleges and Secondary Schools of the Southern States, Association of Colleges and Secondary Schools of the Middle States and Maryland, and the North-West Association of Secondary and Higher Schools.

towards placing the student in some appropriate employment. "With the development of personnel procedure," says Dr. Robertson, "including greater attention to the analysis of individual abilities and achievements, there has come a desire to have useful occupational information. . . . When the world's work has been analysed and the skills and qualities required for particular jobs have been specified, the schools and colleges can shape their curricula and methods of instruction to attain more quickly and effectively the objectives of education as they pertain to vocations." This passage is significant of the trend of much of recent American research in the field of higher education. Attention is focused more on brains and service, and less on bricks and mortar.

Meristematic Tissues of Plants.

IT should be unnecessary to emphasise the importance of focusing attention on plant meristems, and yet the subject is one which is either sadly neglected or receives but scant attention. Botanists with a progressive or inquisitive turn of mind will therefore read with interest Prof. J. H. Priestley's paper on plant meristems (*Biological Reviews*, vol. 3, No. 1).

Different types of meristem are passed in review from a 'causal' viewpoint, and an attempt is made to show that each stage in development depends on preceding events, and releases in turn a system of internal correlating factors which control the progress of growth. The author draws a sharp distinction between shoot meristems, which are superficial, and root meristems, which are deep-seated, and gives some tentative reasons why their continued developments are markedly different. Repeated microchemical tests have confirmed his conclusion that the walls of the root meristem cells are in a more undifferentiated state than those of the shoot, being still impregnated with fatty and protein materials.

Now, postulating the passage of nutrient substances along differentiated cellulose walls, Prof. Priestley considers that most of the divisions in root meristems are internal because food material has some difficulty in passing to the outermost layers of cells. At the same time, divisions occur for the most part in a plane transverse to the root axis, giving the *Rippenmeristem* of Schüepp. Both of these factors are used to explain why the root grows mostly in length. In the shoot meristem, on the other hand, sap passes readily along the more differentiated cell walls, with a resulting greater division of cells in the superficial layers. Thus the primordia of bud-scales, leaves, and flowers are laid down. The repeated tangential divisions of cambium cells, contrary to Errera's Law, are explained by the fact that cambium cells are never in equilibrium with the surrounding cells, lying as they normally do across a hydrogen ion gradient between phloem and xylem.

Some interesting suggestions are put forward regarding the position of the cambium elements formed just behind the root tip. In a former paper by Dr. Pearsall and Prof. Priestley, it was shown that the reaction of cambium (in terms of hydrogen ion concentration) is intermediate between the relatively alkaline phloem and the relatively acid xylem. This reaction is approximately the reaction at which most plant proteins are isoelectric, and in the vicinity of which most protoplasmic synthesis takes place. In the young root, the protophloem groups and the protoxylem groups, on alternate radii, exude their saps respectively alkaline and acid, and in the regions where these saps intermingle, the hydrogen ion concentration necessary for the formation of cambium obtains.

Orientalists at Oxford.

NOT only was the Seventeenth International Congress of Orientalists, which was held at Oxford on Aug. 27–Sept. 1, the first meeting of that body since the War, but it was also the largest gathering that had ever taken place. It is an encouraging sign of the position of orientalists' studies at the moment that, in addition to the ordinary members, there were present two hundred official delegates, who represented the principal governments and universities of the world. Notwithstanding the fact that the meeting took place in mid-vacation, Oxford provided ample entertainment for her guests in the form of garden parties, etc. An official luncheon was given by the British Government in the hall of Christ Church on the opening day, at which Sir William Marris, member of the Council of India, presided. In welcoming the delegates he paid an eloquent tribute to the work of Sir George Grierson in the Linguistic Survey of India. A banquet was held on the evening of Aug. 31.

The Congress met in eight sections, each with its own chairman, Lord Chalmers presiding over the whole. The sections with their presidents were as follows: (1) General, Prof. J. L. Myres; (2) Assyriology, Prof. S. P. Langdon; (3) Egypt, Prof. F. Ll. Griffith; (4) Central and Northern Asia, Prof. F. W. Thomas; (5) the Far East, Prof. W. E. Soothill; (6) (*a*): 1. Ancient India, 2. Modern India; (*b*) Iran, Armenia, and the Caucasus, Prof. F. W. Thomas; (7) Hebrew and Aramaic, Prof. G. A. Cooke; (8) Islam and Turkey, Prof. D. S. Margoliouth; (9) Oriental Art, Sir Michael Sadler.

The proceedings covered a wide range, as may be gathered from the fact that one paper even dealt with the languages of Australia. Perhaps Assyriology held pride of place in attracting attention, and justified the title applied to it by Prof. Langdon when he called it the "Queen of modern Historical Research." In his survey of recent developments in the subject, he emphasised the value of the German discoveries in Hittite Boghaz Keui, the extension of our knowledge of Sumerian, the recovery of the lists of early dynasties at Ur, and the "astonishing" discoveries in the Indus Valley. Mr. Woolley's account of his excavations at Ur and the evidence for human funerary sacrifice aroused much interest; but perhaps the most appropriate of all the items in the programme was the opening of this section on the first full day of the proceedings of the Congress with a paper by the veteran scholar, the Rev. A. H. Sayce, now in his eighty-third year.

It was significant of the breadth of interest of the Congress as a whole that the chair in the Section of Oriental Art was taken by Sir Michael Sadler, Master

of University College, Oxford. His presidential address on "Recent Influences of Oriental Art upon Western Painting and Literature" showed remarkable discernment in tracing the influence of eighteenth century *chinoiseries* in the drawings of Cozens and Gilpin, while pointing out, with a characteristically stimulating grasp of essentials, the affinity between Wordsworth's attitude to Nature and that of the great Chinese painters.

Except for the specialist who confines himself to one subject, the variety of the Congress was rather bewildering; while the number of papers precludes mention of more than a brief and entirely inadequate selection. Many, of course, were highly technical in their interest. Among those of wider appeal, even if technical in character, may be mentioned Prof. Zeitlin's discussion of the authenticity of the recently discovered "Jesus" passage in the Slavonic Josephus, to which Dr. Gaster stated that he had found similarities in a Rumanian version discovered by himself; Dr. H. Farmer's analysis of the information relating to Greek music to be found in Arabic writers; and a paper by Kuoprulu Zade Fuad Bey, which in discussing Omar Khayyám's belief in metamorphosis, produced fifty-three new quatrains of his verse.

Some remarkable customs were described by Mr. B. Thomas in a thrilling account of his travels in parts of southern Arabia never trodden by Europeans, during which he discovered non-Arab tribes speaking four different languages, possibly Semitic, not understood by the Arabs. It was suggested that these tribes were Hamitic. Of both linguistic and cultural significance was Dr. Alan Gardiner's communication on the Sinai script, in which he held that his decipherment proved the origin in the Sinai script of both the Phenician and our own alphabetic script. The Commission from Malta brought forward a paper which supported the view that the Maltese language originated in an Arabic tongue of North Africa with Phenician elements.

The work of archæological excavation in areas covered by the Congress was well represented. Mr. Woolley, on Ur, has already been mentioned. Mr. C. Firth on the excavations at Saqqara, and Mr. Guy on the work in Palestine at Megiddo, which brought to light buildings conjectured to be the stables of Solomon, were also highly appreciated. Prof. Chiera, in describing a wealthy Babylonian's house excavated by the American School of Oriental Research at Nuzi, near Kirkuk, brought forward some interesting suggestions as to the domestic arrangements of the period. The house had been destroyed by fire, presumably at the hands of Assyrian raiders, and the condition of the remains of the clay brick walls, which had evidently been subjected to intense heat, suggested that the rooms had contained a considerable quantity of wooden furniture.

In more purely literary and scholastic subjects, the Institute of St. Joseph of Beirut received well-merited recognition for the account of its work on the preparation of the "Bibliotheca Arabica Scholasticorum."

Finally, mention must be made of two resolutions passed by the Congress: one was in response to a paper by Pater Schmidt, urging the establishment of an organisation for the systematic study of Australian languages; and the other urged upon the governments of the Near and Middle East the need for increasing the facilities granted to accredited excavators, and removing certain disabilities to which they are at present subject—a question raised by Mr. Guy of Palestine.

The next meeting of the Congress will be held in 1931 in Holland, probably at Leyden.

University and Educational Intelligence.

OXFORD.—Under the will of Mr. W. W. Rouse Ball, of Trinity College, Cambridge, who died on April 4, 1925, sums of money were bequeathed for the foundation of Rouse Ball chairs of mathematics at Oxford and Cambridge. Early this year, Prof. J. E. Littlewood was appointed to the Cambridge chair, and now Prof. E. A. Milne, Beyer professor of applied mathematics in the University of Manchester, has been appointed as from Jan. 1, 1929, to the Rouse Ball professorship of mathematics at Oxford. Prof. Milne's duties will be to give instruction in mathematical physics, and he may also give lectures on the history of mathematics in accordance with the wishes of the founder. Subject to certain conditions, a non-stipendiary fellowship at Wadham College is attached to the chair.

DALHOUSIE University, at Halifax, Nova Scotia, has instituted a chair of fisheries and a degree of bachelor of science in fisheries. In co-operation with the Biological Board of Canada, through which the Ministry of Marine and Fisheries controls the Marine Biological Station at Halifax, the University is providing a four-year course combining with instruction in the fundamental sciences practical teaching of the general principles of fish culture, salting, drying and canning methods, freezing and smoking methods, and marine biology. Instructors will be provided by the Biological Board.

FOR four years past the Polytechnic, Regent Street, London, W.1, has, in an experimental way, provided courses of instruction in industrial administration. A co-ordinated course has now been arranged, and examinations will be under the joint control of the Institute of Industrial Administration and the Polytechnic. The course is designed to help those ambitious men and women who have the personal qualities of leadership but require in addition a sufficient training in the technique of industrial administration to undertake the management of business organisations. Related courses of lectures on "The Effect of Government on the Economic Structure of the United Kingdom" will be given at the Polytechnic by the Right Honourable Dr. William Graham, and by diplomatic representatives of South American States on "The Economic Resources of South America." Details can be obtained from the Director of Education of the Polytechnic.

THE depressed state of the coal industry has directed attention to the need of more scientific treatment of fuel, and it is pleasing to note that the Sir John Cass Technical Institute, London, E.C.3, has arranged a five-year course dealing with coal carbonisation, the classes being held in the evening in order to meet the requirements of those engaged during the day. Every phase of the subject is covered, and students attending the course can enter for the certificate examinations of the Institution of Gas Engineers. It is particularly interesting to notice that post-graduate students are also encouraged to offer coal carbonisation as a subject for the M.Sc. degree. The scheme will be inaugurated in the forthcoming session by a course of lectures on gas manufacture by Mr. H. D. Greenwood. The general extent of the curriculum is indicated by the inclusion of lectures dealing with such subjects as fuel and refractories, applications of engineering, and gas analysis. Those wishing to qualify for executive positions are offered a course on English law as related to chemical industry, and chemists will be interested in a course on chemical plant by a panel of special lecturers.

Calendar of Customs and Festivals.

September 12.

Winchester fair, once one of the great fairs of the British Isles, exemplifies the customary surrender of civic authority. The keys of the four gates were surrendered to a magistrate appointed by the bishop.

September 14.

HOLY ROOD OR HOLY CROSS DAY.—In Great Britain the day is specially associated with nutting. It was the custom of Eton that a holiday should be given for nutting on this day. In the Highlands of Scotland the night succeeding Roodmas was called 'the Night of the Holy Nut.' It was a popular belief that on this day the devil went nutting. If on the night before Roodmas it were wet, it was said that "the deer took his head wet into the rutting season," and there would be a month of fine weather and the farmer need have no fear for his crops.

September 15.

FESTIVALS IN ANCIENT MEXICO.—In the latter part of August or early in September a festival was held in honour of 'the Mother of the Gods,' when a woman clad in the ornaments of the goddess was sacrificed. Her body was immediately flayed and a young man dressed in the skin, with the exception of the skin of the thigh, which was worn by another man as a mask, who called himself the Maize Goddess, and the 'daughter' of the Mother of the Gods. A similar sacrifice in honour of the maize goddess took place on Sept. 15. This was in part a purificatory ceremony, as it was preceded by a fast of some days, at the end of which a woman personating the Goddess of the Lepers was sacrificed. It was also in part a fertility ceremony, as the blood of the 'Maize Goddess' was sprinkled over corn, fruits, the image of the goddess, and the walls of the room in which the sacrifice took place. A procession followed the sacrifice, which was headed by a man dressed in the skin, clothes, and ornaments of the 'goddess.'

HARVEST.—In the primitive agricultural year the two solemn festivals of the spring sowing and the harvest of late summer correspond to the observance of the opening of summer in May and the beginning of winter in November in the pastoral year; and just as the winter festival is associated with the cult of the dead, it is sometimes found that a part of the harvest observance is a propitiation of departed spirits. It marks the end of the old and beginning of the new year.

Owing to the conservatism of the peasant and the vital character of the operations with which they are connected, harvest customs long retained features more readily to be identified as survivals of primitive belief than almost any other groups of folk practices. Their importance among the heathen was early recognised by the Church, though they were sometimes thought to have been borrowed from the first-fruit ceremonies of the Jews, and notwithstanding the aversion from pagan practices, some of the ritual, for example, such as that of Vacuna, to whom Sabine rustics sacrificed at the end of harvest, was countenanced in the Christian thanksgiving—"chaplets of corn which She (the Roman Church) suspends on poles" and "offerings . . . on the altars of her tutelar gods." Indeed, a puritanical writer of the seventeenth century censures as a breach of the second commandment "the adorning with garlands or presenting unto any saint whom thou hast made special choice of to be thy patron and advocate, the first-fruits of thy increase, as corne and grains and other oblations."

It is a custom widespread throughout Europe that the last sheaf of corn to be cut should have a special name, should be woven or tied into a special shape, should sometimes be cut by a special person and with special ceremony, and usually be preserved for a year or more. Sometimes the grain from this special sheaf is mixed with the seed corn of the next sowing. This is the spirit of the corn known as the 'corn' or 'kern baby,' 'corn maiden,' 'corn mother,' 'corn dolly,' and so forth. The spirit is sometimes known by an animal name such as the 'hare,' for reasons apparent to anyone who has watched the cutting of corn in a hare country, or the 'mare' in Hertfordshire, where the last sheaf was cut by the harvesters throwing sickles at it. An interesting blend of Christian and pagan observed a few years ago in northern Italy consisted of a corn baby on a small stool or platform surrounded by a circle of twelve other corn babies.

Some significant ceremonies are recorded when the corn baby had been cut. In North Devon, where the figure was known as a 'neck,' a ring was made. The reaper in the centre held the neck in his two hands near the ground, while the others, taking off their hats, lowered them to the ground, then all cried "the neck" in harmony. As the central figure raised the neck they lifted their hats slowly above their heads to the full extent of their arms three times, and then changed their cry to "wee yen."

This circle—an act of adoration—reappears in certain East Anglian customs. In Norfolk any stranger entering the field during harvest operations was approached by the leader with a demand for 'largess.' If a gift was received the largess was 'holloed' by all the reapers standing in a circle around the giver with their arms holding their sickles extended towards him. They then shouted three times at the command of their leader, who stood on any elevated post near by. Largess given at the harvest supper—the 'Horkey Supper'—by the farmer's guests was holloed in similar fashion, the central figure holding a *gulch* of ale and a horn, the circle all holding each other's hands. At the blowing of the horn the clasped hands were elevated as high above the head as possible without losing the hand-clasp. Three whoops then followed and all drank of the ale in turn.

That the blades of corn last cut were regarded as a person was shown not only by the semblance of the human form into which they were woven, but also by the way in which they were treated after cutting. In Perthshire 'the maiden' was entrusted to the most personable of the girls, who bedecked it with ribbons. In Kent it was the business of the women to deck the 'ivy girl,' which was composed of the finest corn the field produced, with paper trimmings cut to resemble cap, ruffles, and handkerchief, etc., of point lace. In Northumberland the 'harvest queen' was an image which was apparelled in great finery with a garland on its head and a sheaf of corn under its arm and a scythe in its hand. This was carried out of the village on the concluding day of harvest, and fixed to a pole in the field. There it remained all day and was carried home at night when the reaping was finished. In the Cotteswolds at the beginning of the last century, a gaily decked girl, who apparently represented the goddess of the harvest, rode on the first of the horses bringing home the last load.

The last load generally, though not always, carried the corn baby, and was usually gaily decked. Its ceremonial character was emphasised in Gloucestershire. It came from the farthest field, and it should be the smallest, not topping the rail, so that women and children might ride on it. By taking it from the farthest field it was ensured that its beneficial influence should cover the greatest stretch of ground.

Societies and Academies.

PARIS.

Academy of Sciences, July 23.—G. Bigourdan: Some sunspot observations hitherto unpublished, made at the Paris Observatory from 1683 to 1719 by Ph. La Hire and by G. Ph. La Hire.—**L. Blaringhem:** The fertility of *Hemerocallis fulva*.—**P. Helbronner:** The figure of the earth deduced from the measurement of the arc of the meridian of the French Alps.—**Léon Pomey:** The theory of algebraical curves.—**E. Cartan:** The Betti numbers of spaces of closed groups.—**Silvio Minetti:** An upper limit of the increase of the maximum modulus of an integral function of finite genus.—**R. Duchêne:** The influence of lead tetraethyl on the deflagration of gaseous hydrocarbon mixtures. The effect of the addition of 5 per cent of lead tetraethyl to a hexane-air mixture, and the photographs of the flame produced on explosion, point to the fact that the lead compound exerts an antidotonating action in a homogeneous gaseous mixture.—**L. d'Azambuja:** Images of the solar chromosphere obtained in the spectroheliograph with the infra-red line λ8542 of ionised calcium.—**Louis Pirot:** Determinations of astronomical positions by means of the prism astrolabe.—**A. Launert:** The action of mixtures of salts on copper. The mixtures used were potassium and strontium chlorides, potassium and barium chlorides, barium and strontium chlorides. Rods of copper were heated in these mixtures to temperatures below the eutectic points (530° C. to 725° C.), and the changes in the density and electrical resistance of the metal measured.—**R. Jouaust:** The phenomena of propagation of radiotelegraphic waves. The phenomenon of the aurora has been explained as being due to ionisation at a great altitude (200 km. to 400 km.) caused by particles emanating from the sun. It is suggested that this same ionised layer is responsible for the reflexion downwards of the electromagnetic waves.—**F. Bedeau and J. de Mare:** The stabilisation of the oscillations of relaxation.—**Maurice Lambrey:** The absorption spectrum of nitric oxide. Completion of work discussed in an earlier communication.—**Paul Soleillet:** The polarisation of the resonance radiations of cadmium.—**Jean Becquerel:** The existence, for a uniaxial crystal, of two different magnetic rotatory powers, along the axis and along a normal to the axis.—**Armand de Gramont and Georges Mabboux:** Applications of ultra-microscopic illumination to the bubble of a spherical level.—**Jean Thibaud:** The refractive index of glass for X-rays of great wave-length.—**L. Mallet:** The spectral study of the luminescence of water and carbon disulphide submitted to the gamma radiation.—**G. Allard:** An allotropic state of silver. Ordinary silver has been shown by the X-ray method to be cubic. The silver obtained by the action of copper upon a solution of silver nitrate examined by the powder method gives a series of lines quite incompatible with a cubic structure and has proved to be orthorhombic.—**René Delaplace:** The gaseous contraction of hydrogen submitted to the electric discharge. Previous work on this subject has led to the suggestion that the abnormal contractions observed are due to a polymerisation of the hydrogen. In the experiments described the discharge tubes were made of Pyrex glass, without tap or ground joint, and cleaned by heating in a vacuum to 400° C. A contraction was observed, but the presence of methane and of carbon monoxide was proved.—**André Léaute:** Results of briquetting coal by means of hydrocarbons partially dehydrogenated by sulphur.—**Arakel Tchakirian:** The volumetric estimation of germanic acid: studies of some hydrated forms of this acid and its salts.—**Adolphe Lepape:** The separation of krypton and xenon from atmospheric air. In preparing krypton and xenon by the slow evaporation of liquid air, the yields are extremely small owing to the fact that as the liquid phase diminishes the proportion of the two gases escaping with the oxygen increases. A method of reducing these losses is given. A litre of xenon and several litres of krypton have been prepared.—**R. Levaillant:** A new method of preparing alkyl sulphates. The reaction proposed is

$$Cl.SO_2.OR + NO.OR' = SO_2(OR)(OR') + NOCl,$$

in which R and R′ are alkyl groups.—**A. Morel and P. Preceptis:** The reciprocal actions of picric acid and cycloglycylglycine.—**G. Delépine:** The age of the grits of Naranco (Asturia). The fauna of these ferruginous grits clearly points to their age as middle Devonian.—**R. Esnault-Pelterie:** The law of the constitution of the atmosphere. A discussion of the formulæ proposed for giving the density of the air as a function of the altitude.—**N. P. Péntcheff:** The rare gases of thermal springs and the earthquakes of April 14 and 18, 1928, in Bulgaria. Although the amount of water issuing from the springs was changed by the earthquakes, the proportions of helium and argon remained the same.—**V. Ghimpu:** Contribution to the caryological study of the genus *Medicago*.—**Maresquelle:** The respiratory exchanges of plants attacked by the Uredineæ.—**Laurent Rigotard:** Alpine agronomy applied to the study of the formation of arable soils.—**E. Miège:** The presence of forms of the Inflatum type in *Triticum durum*.—**V. Pertzoff:** The lipase of the caterpillars of *Galleria mellonella*.—**F. Rathery, R. Kourilsky, and Mlle. Yv. Laurent:** Insulin, folliculin, and glycæmia in the normal dog.—**Philippe Fabre:** Electrocardiography by means of commercial oscillographs.—**Edm. Sergent, A. Donatien, L. Parrot, F. Lestoquard:** The transmission of bovine piroplasmosis to *Theileria dispar* of north Africa by the tick *Hyalomma mauritanicum*.—**E. Marchoux:** Man is less sensitive than *Macacus rhezus* to the virus of yellow fever.—**J. Bridré, A. Donatien, and D. Hilbert:** Stovarsol, a specific against contagious agalaxy of the sheep and goat.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 13).—**B. I. Dolbeshkin:** The occurrence of *Ædes caspius* Pall. in Orenburg.—**B. I. Dolbeshkin:** Fauna of mosquitoes of the Dnieper basin. A list of species with localities.—**V. V. Gorickaja:** The problem of infection of *Anopheles maculipenis* by malarial plasmodia under natural conditions. Dissections of mosquitoes collected in different habitats showed that the percentage of mosquitoes infected with malarial plasmodia is higher in houses than in stables; the presence of subjects suffering from malaria is reflected in a higher percentage of infected mosquitoes.—**L. V. Burakova:** Mosquito fever and mosquitoes of Crimea. A preliminary report of the expedition for the study of the papataci fever and the distribution of *Phlebotomus spp.* in Crimea.—**N. I. Chodukin:** Does *Anopheles algeriensis* (Theob.) exist in Turkestan? Turkestan mosquitoes recorded as *Anopheles algeriensis* var. *turkestanicus* belong to the species *A. bifurcatus* L.—**N. I. Chodukin:** Kala-azar in Tashkent and its relation to the epidemiology of the leishmaniasis of dogs. All the foci of kala-azar in Tashkent have been found to coincide with the foci of dog leishmaniasis, and it is suggested that the infection is transferred not by fleas, but probably by mosquitoes.—**E. N. Pavlovsky, A. K. Stein, and P. P. Perfiliev:** Experimental studies on the active principles of saliva of *Culex pipiens* on the skin of man. Saliva is more active than extracts from the œsophagal bladders.

SYDNEY.

Linnean Society of New South Wales, June 27.—**A. B. Walkom**: Fossil plants from the Upper Palæozoic rocks of New South Wales. Four species of fossil plants are described from the Kuttung Series, namely, *Ulodendron minus*, *Stigmaria ficoides*, a new species of *Pitys* (?), and a new species of *Lepidodendron* similar to *L. spitsbergense*. These plants indicate that the flora of the Kuttung Series is related to floras of Lower Carboniferous age in the northern hemisphere. A new species of *Dadoxylon* is described from the Ravensfield sandstone, in the Lower Marine Series.—**T. L. Bancroft**: On the life-history of *Ceratodus* (*Epiceratodus forsteri*). During a period of seventeen years many thousands of *Ceratodus* have been hatched, but the author only succeeded in rearing two past the critical three months' stage. The secret of successfully negotiating this stage has now been discovered, and a description of the technique is given. The great importance of this lies in the fact that conditions for favourable propagation of *Ceratodus* no longer exist in the Burnett River, and the fish must be gradually nearing extinction in that river.—**J. R. Malloch**: Notes on Australian Diptera. No. 14. This part deals with Asilidæ (subfamilies Laphrinæ and Dasypogoninæ), Chloropidæ (one subgenus and three species of *Parahippelates* are described as new, and a key is given to the species of that genus), Lonchæidæ (a key is given to the species of *Lonchæa*, one species is described as new, and notes are given on other species), Sepsidæ (one genus and one species are described as new) and Piophilidæ (one genus and one species are described as new).—**A. B. Walkom**: Lepidodendroid remains from Yalwal, N.S.W. Lepidodendroid stems from Yalwal are referred to two species (described as new) of *Protolepidodendron* and one species of (?) *Lepidodendron*. The former show resemblances to *P. primævum* from the Upper Devonian of New York, and support the reference of the Yalwal rocks to the Devonian.—**C. P. Alexander**: The Australasian species of the genus *Nemopalpus* Macquart (Diptera, Psychodidæ). A second species of the genus is described from the Dorrigo Plateau in New South Wales. Keys are given for the recognition of the subfamilies of Psychodidæ, the genera of Bruchomyinæ and the species of *Nemopalpus*.—**H. J. Carter**: Revision of the Australian species of the genera *Curis*, *Neocuris*, and *Trachys*, together with notes and descriptions of new species of other Coleoptera. Amongst the Buprestidæ four species are described as new, many notes on synonymy are given, and the results of critical examination of recent work by Dr. Obenberger are recorded. One genus and six species of *Tenebrionidæ*, five species of *Cistelidæ* and one species of *Cerambycidæ* are also described as new.

VIENNA.

Academy of Sciences, June 21.—**P. Gross** and **K. Schwarz**: The separating action of salts. An nquiry into the distribution of acetone and of ydrocyanic acid between benzol and aqueous olutions of electrolytes and some non-electrolytes. —**P. Gross**: The action of neutral salts.—**A. Müller** and **E. Rölz**: A new preparation of 1, 5-ioxy-*n*-pentane (pentamethyleneglycol) and 1, 5-di-d-*n*-pentane.—**R. Weiss**: Researches on the preparation of acridone derivatives.—**R. Weiss** and **E. Merksammer**: A new synthesis of cumarin derivatives. —**E. Blumenstock-Halward** and **E. Jusa**: The colour eepening action of the methyl-mercapto group in o dyes (1).—**E. Blumenstock-Halward** and **E. Riess**: he colour deepening action of the methyl-mercapto oup in azo dyes (2).—**G. Koller** and **E. Strang**: A synthesis of 2.4-dioxy-6,7-benzo-1,8-naphthydrin-3-carbonic acid-methylester.—**A. Tornquist**: The system of lead-zinc-pyrites mineralisation in the hills of Graz. —**A. Kieslinger**: Geology and petrography of the Kor Alps. (7) Eclogite and amphibolite. (8) Pararocks.—**A. Musger**: Etiology of Nicholas-Durand-Favre's disease. Apparently it is due to coryne bacteria.—**E. Haschek**: A contribution to the Young-Helmholtz theory. The hypothesis of three visual substances in the retina with separate photochemical sensitivities and regeneration constants.—**L. Holzer**: The determination of Lebesgue's measure of linear point manifolds the elements of which are given by systematic development.—**L. Hajek**: New recording apparatus of the Vienna phonogram archives.—**Z. Dische**: The nature of the albumen-fixed plasma sugar. The sugar was from horse blood and includes a non-dialysable blood-sugar partly an easily fermentable *d*-mannose and partly a non-fermentable sugar.—**A. Zinke**, **A. Dadieu**, **K. Funke**, and **A. Pongratz**: Researches on perylene and its derivatives (17).—**A. Pongratz**: Researches on perylene and its derivatives (18).—**O. Dischendorfer**: A disintegration acid of α-naphthol.—**K. Przibram**: Contributions to the coloration of salts. Crystals from molten rocksalt show blue coloration under sufficient pressure.—**C. Doelter** and **H. Hueber**: The colouring substance in blue rock-salt. Chemical inquiries as to alkalinity with phenolphthalein.—**O. Grube**: On numbers prime to each other and the sums of their powers.

Official Publications Received.

BRITISH.

The Tea Research Institute of Ceylon. Bulletin No. 2: Annual Report for the Year 1927. Pp. 43. (Kandy, Ceylon.)

The Quarterly Journal of the Geological Society. Vol. 84, Part 2, No. 334. Pp. xlix-cv+179-381+13 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6*d*.

Apia Observatory, Samoa. Report for 1924. Pp. 84. (Wellington, N.Z.: W. A. G. Skeinner.)

British Association for the Advancement of Science, Glasgow Meeting, 1928. Daily Time-Table: Preliminary Issue. Pp. 23+xix. Excursion Arrangements: List of Excursion Fares and Trains available during the Period from 6th to 12th September 1928. Pp. 85. Visits to Works. Pp. 20. (London.)

FOREIGN.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 20, Part 5: Chemical Studies on the Ripening of Rice-seed and Chemical Properties of Rice of the Early Ripening Subvarieties, by Tetsutaro Tadokoro; On the Differences in Physico-Chemical Properties of various Proteins in Plant Seeds. Third Report: On the Differences in the Physico-Chemical Properties of the different Kinds of Soy-bean Proteins. By Tetsutaro Tadokoro and Katsuji Yoshimura. Pp. 333-302. (Tokyo: Maruzen Co. Ltd.)

Proceedings of the Imperial Academy. Vol. 4, No. 6, June. Pp. xxi-xxiv+255-318. (Tokyo.)

U.S. Department of Agriculture: Bureau of Biological Survey. North American Fauna. No. 51: A Taxonomic Review of the American Long-tailed Shrews (Genera Sorex and Microsorex). By Hartley H. T. Jackson. Pp. vi+238+13 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

Diary of Societies.

FRIDAY, SEPTEMBER 7.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

SATURDAY, SEPTEMBER 8.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District Meeting) (at Town Hall, Great Yarmouth), at 11.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District Meeting) (at Town Hall, Morpeth), at 2.

THURSDAY, SEPTEMBER 13.

CERAMIC SOCIETY (Refractory Materials Section) (at Royal Technical College, Glasgow), at 10.30 A.M.—P. Cooper: Refractory Formers for Electric Heating Elements: some Problems in the Manufacture and Use.—W. Emery: Notes on Refractories for Salt Glass Kilns.—A. T. Green: The Functions of Regenerators in Relation to the Properties of the Refractories of Construction.

FRIDAY, SEPTEMBER 14.

CERAMIC SOCIETY (Refractory Materials Section) (at Royal Technical College, Glasgow), at 10 A.M.—C. Edwards: Jointing Cement.—W. J. Rees: A Comparison of the Properties and Industrial Durability of Lime-bonded and Clay-bonded Silica Bricks.—W. J. Rees and D. W. Hubbard: The Dissociation of Carbon Monoxide in Contact with Fireclays and Silica.—C. E. Moore: Drying Cracks.—A. J. Dale: Aluminous Refractories and their Industrial Significance.

SATURDAY, SEPTEMBER 15.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Town Hall, Swanage), at 11.30.

CONGRESSES.

SEPTEMBER 5-12.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Glasgow).

Friday, Sept. 7.

At 10 A.M.—

Dr. R. A. Sampson, and others: Discussion on the Photographic Measurement of Radiation.

Dr. J. Vargas Eyre, and others: Discussion on Fermentation.

Sir William Ellis: The Influence of Engineering on Civilisation (Presidential Address to Section G).

Dr. H. E. Magee, Prof. E. P. Cathcart, Capt. J. Golding, and Dr. N. C. Wright: Joint Discussion on Lactation and Nutritional Factors allied thereto.

Dr. Cyril Norwood: Education: the Next Steps (Presidential Address to Section L).

At 11 A.M.—

Prof. T. H. Pear: The Nature of Skill (Presidential Address to Section J).

Saturday, Sept. 8.

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. E. A. Westermarck: The Study of Popular Sayings (Frazer Lecture in Social Anthropology).

Sunday, Sept. 9.

At 11 A.M.—

Official Service in the Cathedral Church of St. Mungo. Preacher: Rev. Dr. Lachlan Maclean Watt.

Monday, Sept. 10.

At 10 A.M.—

Prof. A. W. Porter: The Volta Effect: Old and New Evidence (Presidential Address to Section A).

E. B. Bailey: The Palæozoic Mountain Systems of Europe and America (Presidential Address to Section C).

Prof. Allyn Young: Increasing Returns and Economic Progress (Presidential Address to Section F).

Sir George Macdonald: The Archæology of Scotland (Presidential Address to Section H).

At 11 A.M.—

Prof. C. Lovatt Evans: The Relation of Physiology to other Sciences (Presidential Address to Section I).

Prof. F. O. Bower, and others: Discussion on the Size Factor in Plant Morphology.

At 11.15 A.M.—

Dr. H. H. Read, Dr. Gertrude Elles, and others: Discussion on Problems of Highland Geology.

At 11.30 A.M.—

Prof. T. H. Pear, Prof. H. Clay, and C. G. Renold: Joint Discussion on the Nature and Present Position of Skill in Industry.

Tuesday, Sept. 11.

At 10 A.M.—

Dr. C. J. Davisson, and others: Discussion on the Scattering of Electrons by Crystals.

Sir William Pope, and others: Discussion on Recent Advances in Stereo-chemistry.

Prof. F. E. Suess, and others: Discussion on the Tectonics of Asia.

J. A. Venn, Dr. J. S. King, and others: Joint Discussion on the Incidence of Taxation in Agriculture.

G. E. Briggs, Dr. F. G. Gregory, and others: Discussion on the Interpretation of Growth Curves.

Aims of, and Developments in, Broadcasting. Papers:—(*a*) Sir John Reith: Wireless in the Service of Education. (*b*) Salter Davis: An Experiment in Educational Broadcasting.—Sir Oliver Lodge, W. A. Brockington: Discussion.

At 12 NOON.—

Prof. T. H. Mortensen, Dr. F. A. Bather, and others: Discussion on Bothriocidaris and the Ancestry of Echinoids.

At 2 P.M.—

Conference of Delegates of Corresponding Societies.

At 2.15 P.M.—

Prof. F. E. Fritsch, R. Gurney, and others: Joint Discussion—A Biological Investigation of British Fresh Waters.

Dr. G. S. Carter: The Conditions of Life in a Tropical Swamp: an Investigation of the Swamps of the Paraguayan Chaco (Lantern Lecture).

At 2.30 P.M.—

Prof. E. Taylor-Jones: Spark Ignition (Lecture).

Dr. J. D. Sutherland, and others: Joint Discussion on the Economic Balance of Agriculture and Forestry.

At 2.45 P.M.—

Discussion on the Position of Geography in Scottish Schools.

At 5 P.M.—

Sir John Stirling-Maxwell, Bart.: Forestry in Scotland: Past, Present, and Future (Lecture).

At 8.30 P.M.—

(In Royal Technical College Hall, George Street.) Prof. F. G. Donnan: The Mystery of Life (Evening Discourse).

Wednesday, Sept. 12.

At 12 NOON.—

(In Fore Hall, University.) Concluding General Meeting.

SEPTEMBER 10-13.

INTERNATIONAL CONFERENCE ON LIGHT (at Lausanne and Leysin).—Among the subjects to be discussed are the Methods of Measuring the Energy and Biological Activity of Light Rays; Irradiated Foods and Sterols; the Climatic and Light Therapy of Various Forms of Tuberculosis.

SEPTEMBER 12-15.

CONGRESS OF THE GERMAN PHARMACOLOGICAL SOCIETY (at Hamburg).

Sept. 13.

Discussions on the Work of the Heart and Vessels in Honour of William Harvey, with papers by Liljestrand, Jarisch, Straub, Anrep, and Mansfeld.

Sept. 14.

Papers by Flury and Zangger on Modern Industrial Intoxications.

Sept. 15.

Paper by Barger on Ergot Bases.

SEPTEMBER 14-17.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Fifth Annual Conference) (at New College, Oxford).

Friday, Sept. 14.

At 7.15 P.M.—

Address by the President of the Conference.

At 8.30-9 P.M.—

Dr. R. S. Hutton: The Work of Aslib.

At 9-10 P.M.—

Dr. A. P. Thurston: Patent Law Reform, with Special Reference to the Search for Novelty.

Saturday, Sept. 15.

At 9.30-12 NOON.—

N. Parley: The Direct Reproduction of Books and Manuscripts.

Dr. E. H. Tripp: Certain Aspects of Agricultural Research.

J. Forbes Marsden: The Literature of Scientific Management.

At 12-12.45 P.M.—

H. H. Johnson: Existing Types of Indexes to Technical Periodicals.

V. Garrett: An Index to Business Data.

J. N. L. Baker: Cartography and the Research Worker.

At 5.30-6.30 P.M.—

Annual General Meeting.

At 8.30-10 P.M.—

H. Jenkinson: The Librarian as Archivist.

F. M. Earle: Vocational Selection and Guidance.

A. Esdaile: Unification of the Library Resources of London.

Sunday, Sept. 16.

At 9.30-11.45 A.M.—

Dr. W. Rosenhain: Scientific Abstracts.

At 11.45-12.45 P.M.—

A. Farquharson: Civic and Regional Surveys: their Relation to Information Bureaux.

At 5-6 P.M.—

C. R. Griffin: A Book-Review Digest.

Capt. J. S. Allan and N. Parley: The Durability of Paper.

Lieut.-Col. J. A. A. Pickard and C. G. Ingall: Information on Accident Prevention.

At 8.30-9.15 P.M.—

Dr S. C. Bradford: The Necessity for the Standardisation of Bibliographical Methods.

At 9.15-10 P.M.—

Lieut.-Col. J. M. Mitchell: The Aslib Directory.

SEPTEMBER 15-22.

GERMAN SOCIETY OF NATURALISTS AND PHYSICIANS (at Hamburg).

SEPTEMBER 19-22.

NATIONAL GLASS CONVENTION (at Bournemouth).—Discussions on the Organisation of the Glass Industry and a Conference on the Legislation Concerned.

SEPTEMBER 24-27.

INTERNATIONALE TAGUNG FÜR BRÜCKEN- UND HOCHBAU (at Vienna).

SEPTEMBER 24-27.

INTERNATIONALE TUBERKULOSEKONFERENZ (at Rome).

SEPTEMBER 24-28.

DIE TAGUNG DER BALTISCHEN GEODÄTISCHEN KOMMISSION (at Berlin).

SEPTEMBER 26-29.

PALÄONTOLOGISCHE GESELLSCHAFT (at Budapest).

SATURDAY, SEPTEMBER 15, 1928.

CONTENTS.

The International Research Council.

THE International Research Council, of which the fourth general assembly was held at Brussels in July, was formed in 1919, and the convention under which it carries on its work will terminate at the end of 1931 unless it has been previously renewed by the countries represented on the Council.

Designed to replace some of the international scientific associations that had lapsed during the War, its aims have been defined to be to co-ordinate international efforts in the different branches of science ; to initiate the formation of international scientific associations ; to direct international scientific activity in subjects not falling within the purview of any existing association ; and to enter into relation with the governments of the countries adhering to the Council in order to promote investigations falling within its competence.

The countries which joined the Council at its formation were fifteen in number, but since then many others have notified their adhesion to it, until at the present time thirty-five countries are represented on the Council and take part in its deliberations.

One of the first acts of the Council was to promote the formation of international associations, or Unions, for the furtherance of certain branches of science in which international co-operation is essential, with the result that the Unions of Astronomy, of Geodesy and Geophysics, of Pure and Applied Chemistry, of Mathematics, and of Radio-Telegraphy were formed in 1919. Later, in 1922, others dealing with Pure and Applied Physics, Biological Sciences, and Geography were organised, thus bringing the total number up to eight.

These Unions are practically autonomous, arranging their own meetings, appointing their own officers, collecting and dispensing their own funds, and initiating research and co-operative work in their own fields of scientific activity, very much as did the earlier associations the work of which they are carrying on.

During the past nine years, each of these Unions has held several meetings at which addresses have been delivered, scientific communications have been discussed, and arrangements have been made for future co-operation and research. The Astronomical Union, which has now been joined by 24 countries, has met at Rome, Cambridge, and Leyden ; the Geodetic and Geophysical Union, which has a membership of 32 countries, has held meetings at Rome, Madrid, and Prague ; the Chemical Union, representing 26 countries, has

hitherto met annually, and has visited Rome, Brussels, Lyons, Cambridge, Copenhagen, Bucarest, Warsaw, and the Hague. The Mathematical Union, to which 18 countries belong, has held meetings at Strasbourg and Toronto, and has just met at Bologna. The Union of Radio-Telegraphy, with a membership of 11 countries, has met at Brussels and at Washington. Of those which were formed later, the Physical Union has met at Paris and Brussels; the Geographical Union has met at Brussels, Cairo, and Cambridge; and the Biological Union at Brussels, Paris, and Geneva. The membership of these three Unions is now 18, 19, and 14 countries respectively.

Thus it will be seen that all these associations are now well supported, and are operating actively and effectively in the promotion of science and in the encouragement of international co-operation. In none of their work does the Research Council intervene. A reference to the published accounts of its meetings will show that most of the questions with which it has dealt are of an administrative rather than of a scientific character. They include invitations to join the organisation, the appointment of its officers and of committees, approval of statutes or of modifications to statutes which have been proposed by any of the Unions, and other matters affecting the Council and the Unions related to it as a whole. On occasions it has appointed committees to carry out special inquiries, such as the one which is studying the relations between solar and terrestrial phenomena, but generally the delegates, of whom it is composed and who are almost without exception delegates also to one Union or another, are called upon to decide questions of administration and not scientific matters. The conception of the Council as a small body which aims at exercising a control in scientific matters falls very wide of the mark, since it is one on which all the thirty-five countries are represented.

In 1926 the delegates of the countries adhering to the Council unanimously decided to invite Germany, Austria, Hungary, and Bulgaria to join the Council and the Unions related to it, and to give effect to this, invitations were sent out immediately after the meeting. At the meeting of the general assembly in July, it was reported that Hungary had accepted the invitation and had joined the Council, but that Bulgaria, for reasons of economy, was unable to do so at present. Germany and Austria had not yet replied. In Germany the matter is believed to be still under consideration by the five scientific academies of that country, namely, those of Berlin, Munich, Leipzig, Göttingen, and Heidelberg; the Academy of Sciences of Vienna is also affiliated to this group of academies. The situation no doubt presents some difficulties, but it is to be hoped that either by the formation of a Research Council for Germany on which the academies would have representation, or by some other means, a satisfactory solution may be found whereby German men of science may co-operate in the work of the Council and of the Unions.

At the meeting of the Astronomical Union, which was recently held at Leyden, German astronomers accepted an invitation to be present, and their co-operation in the discussions was most welcome. Similarly, German and Austrian chemists were invited to and attended the recent congress of the International Union of Pure and Applied Chemistry which was held at the Hague. On the other hand, a similar invitation which was extended to German geographers to attend the International Geographical Congress, which met at Cambridge in July, was declined by them on the ground that it was organised by the International Union of Geography, one of the Unions related to the International Research Council. Their objection to the Council was based on the ground that it was not wholly a scientific association, but was to some extent a political one, since a government may be the body holding membership. But this only occurs in a few cases where there is not at present a national academy to represent the country. As was stated by the general secretary in his report to the general assembly at the recent meeting of the Council at Brussels, out of the thirty-five countries which have joined the International Research Council, fourteen are represented by their scientific academies, six by national research councils composed of representatives of the national academies, one by a scientific society, and seven others by a scientific department connected with its government. In seven cases only out of the thirty-five is the government the adhering body.

The first twelve-year period of the convention under which the Council and the Unions have been working since 1919 is now drawing to its close, and the Council as well as each of the Unions have to consider the renewal of the convention before its expiration on Dec. 31, 1931. The experience of the past nine years has shown that some modification of the statutes, which were adopted in 1919, may be desirable; the Research Council and the Unions are, therefore, occupying themselves with the revision of them where necessary, in order that any changes that may be advisable may be adopted before the present convention expires.

This should provide a very favourable opportunity for clearing up any misunderstandings that may exist, and for an extension of international co-operation on lines that are acceptable generally. It seems unlikely that the right of governments to adhere to the Council and the Unions can be the sole obstacle to Germany's acceptance. The International Geodetic Association and the Seismological Association of former days were both supported by grants furnished by the governments of the States which were members of the associations; and so in this respect there has been little change. There may be other matters which are not acceptable, but it does not appear that up to the present any definite and authoritative statement of them has been made public.

As Sir Austen Chamberlain said at the dinner given by the British Government to the delegates to the International Geographical Congress at Cambridge, German statesmen had been welcomed to the Society of Nations as colleagues and as friends; they had contributed fully to the discussions, and he hoped that, before long, German men of science would accept the welcome which awaited them. If a solution of the present difficulties can be found, and they are enabled thereby to accept the invitation to join the Research Council, they will be able to take part in the discussions on the existing statutes and to assist in drafting such modifications in them as will make for the greater efficiency of the organisation as a whole.

Harrison of Ightham.

Harrison of Ightham: a Book about Benjamin Harrison, of Ightham, Kent, made up principally of Extracts from his Notebooks and Correspondence. Prepared for publication by Sir Edward R. Harrison. Pp. xvi + 395 + 12 plates. (London: Oxford University Press, 1928.) 15*s.* net.

IN writing to Benjamin Harrison, grocer, in the village of Ightham, Kent, in 1906, Sir E. Ray Lankester ended his letter thus: "Good health and happiness to you—courageous and indomitable discoverer of pre-Palæolithic man." Never were words of cheer more timely or better deserved. When this letter reached Harrison he was approaching his seventieth year; he had retired from the counter behind which he had stood for fifty-five years—or to state the matter more truthfully, the counter had retired from him, for the business in which his ancestors had prospered for many generations had become in his hands a rich museum but a poor shop. His only certain source of income then was his Civil List pension of £26 a year granted in 1899, with, in addition, the annuity of £25 given to him in the same year by the Royal Society. In 1918, being then in his eightieth year, his Civil List pension was doubled, and this he continued to enjoy until his death in 1921.

Harrison's activities cover a period in which our conception of human history underwent a revolutionary change. His career began in 1851, while as a schoolboy of thirteen he listened to his eldest brother Tom and his schoolmaster—Stephen Constable—discuss the geology of the Weald, until 1921—a period of seventy years. During this long period, scarcely a morning, an evening, or a Sunday passed without finding him searching his native district for evidence of its prehistory. His pursuits brought him into close contact with the leading geologists, archæologists, and naturalists of the time—Rupert Jones, Grant Allen, Lord Avebury, Sir John Evans, F. C. J. Spurrell, Worthington Smyth, Ray Lankester, Charles Dawson, Lewis Abbott, A. S. Kennard, W. J. Sollas, Smith Woodward, Reid Moir, Russel Wallace, and, above all, Sir Joseph Prestwich, who became his adviser, mentor, and protagonist. It was therefore important that the story of Benjamin Harrison's life should be well and fully told; this has now been done most ably by his son, Sir Edward R. Harrison.

It is quite true that a modern Samuel Smiles could have thrown the glamour of romance over the details of Benjamin Harrison's life, but it is not romance which the historian of science needs, but the sober statement of pertinent facts set out in an orderly and natural manner, and it is this which Sir Edward Harrison has done in the biography of his father. Nowhere does the biographer obtrude himself on the reader; he permits well-chosen extracts from his father's diaries and correspondence to tell the story of a man who was at once one of the most peculiar, yet one of the most outstanding of all the amateurs in science ever bred in England. No claims are made, no defence is set up, no situation is shunned; yet long before the last page is reached it becomes patent to the reader that the biographer is whole-heartedly in sympathy with all his father's labours and aims, and has measured with accuracy their bearing on the trend of scientific discovery. From the pages of this biography emerges the picture of a man, lacking confidence in himself and ever struggling to serve two mistresses—business with her promise of ease, and science with her threat of poverty. Science won every time.

With all the facts now before us, we see that the

chief events of Benjamin Harrison's life form a logical sequence. In a letter to Rupert Jones he wrote (1884): "When I tell you that I have secured 250 implements from this district, it will be seen what an interesting chunk of an old world I am fortunate enough to live near." Ightham did not 'make' Benjamin Harrison; it only gave him his opportunity. Thousands of men had lived in Ightham and saw it only as a village of the Weald, situated between the upper waters of the Darenth and of the Medway near the North Downs. For Harrison it became a page of history crowded with hieroglyphs of various dates. An inborn desire for knowledge came to him from his mother's family; he devoured in his boyhood Lyell's "Elements of Geology," Chambers's "Vestiges of Creation," Cassell's "Popular Educator," White's "Natural History of Selborne," and presently began to interpret his native village and surrounding district for himself.

Then in 1863, as a young man of twenty-five years, Harrison read of Boucher de Perthes' discoveries in the ancient gravel beds of the Somme valley, and at once set out to search the gravel deposits of his native valley. His search was speedily successful; he continued his search day after day and year after year, keeping records of his finds. Having exploited the lower gravels of neighbouring valleys, he moved his search to the higher and older gravels on the watersheds of the Weald, and was again successful. Then in 1878 he moved on to the dome of the North Downs to seek in its ancient gravels for what he called the 'pot hooks' of man's endeavours at implement making.

It was at this time that Harrison succeeded in making Sir Joseph Prestwich interested in his search. Although Prestwich then occupied the chair of geology in the University of Oxford, he lived at Shoreham, in the Darenth valley, eight miles from Ightham, and was deeply interested in the origin of gravel and other deposits which were found on the neighbouring Downs. As Harrison searched the gravel spreads of the Plateau, he found worn palæoliths, but he also observed implements of a ruder kind—flat flints with chipped edges—the type of implement to which Prestwich at a later date gave the name of *eoliths*. Prestwich disciplined Harrison; he would have nothing to do with surface finds; implements which were to be reckoned of historical value must be found *in situ*, and the deposit of gravel which contained them must be determined accurately as to level, distribution, and nature.

In 1882, Harrison commenced a systematic search of the Plateau gravels for eoliths; it was not until 1885 that he was convinced that they had been shaped and used by primitive man. He showed them to Sir John Evans, who gave them his consideration but rejected them. Sir Joseph Prestwich was then closely engaged on his "Textbook of Geology," and it was not until this was finished in 1888 that he found time to examine the results of Harrison's intensive search on the Plateau. On examining Harrison's collection, and after verifying all the sites of discovery, he became convinced that Harrison's contention was justified; eoliths were the work of man's hand, and that man had lived in England at an infinitely more remote date than had hitherto been supposed.

Prestwich soon realised that if ever Harrison's discoveries were to be made known to scientific men, he himself must act as Harrison's spokesman. Hence, early in 1889, Prestwich brought Harrison's implements to the notice of the Geological Society, and later, in 1891, he placed the discoveries on the plateau of the North Downs before the fellows of the Anthropological Institute. In this way the problem of eoliths was launched on the world of debate. Sir Joseph Prestwich fired the gun, but it was the diffident, modest, but indomitable grocer of Ightham who filled the cartridges.

Nature and Man.

(1) *A Naturalist at the Dinner Table.* By E. G. Boulenger. Pp. 160. (London: Gerald Duckworth and Co., Ltd., 1927.) 6*s.* net.

(2) *Animal Life of the Carlsbad Cavern.* By Vernon Bailey. (Monographs of the American Society of Mammalogists, No. 3.) Pp. xiii + 195 (38 plates). (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1928.) 13*s.* 6*d.* net.

(3) *Natural History of Canterbury: a Series of Articles on the Early History of the Province and on the History of Scientific Investigation, up till 1926, as well as on some Results of this Investigation.* R. Speight, Arnold Wall, and R. M. Laing, Honorary Editors. (Issued by the Philosophical Institute of Canterbury.) Pp. x + 299 + 29 plates. (Christchurch, N.Z.: Simpson and Williams, Ltd., 1927.) n.p.

(4) *Birds and Beasts of the Roman Zoo: some Observations of a Lover of Animals.* By Th. Knottnerus-Meyer. Translated by Bernard Miall. Pp. vii + 378 + 40 plates. (London: George Allen and Unwin, Ltd., n.d.) 16*s.* net.

NATURAL history continues to revive quite vigorously after its long sleep. A great many people are coming to see that human affairs

depend in an enormous number of ways upon the activity of plant and animal life, and that man is one member of a community of other species, which either threaten him or else are exploited by him.

(1) If one wished to express a solemn opinion (and most ecologists are rather solemn, at any rate about their own subject), one could call Mr. Boulenger's book a text-book on the ecology of human food-habits, the equivalent of Collinge's "Food of British Birds," or of Hardy's studies on the food of the herring in the North Sea. However, any comparison of this sort would obscure the fact that "A Naturalist at the Dinner Table" is written in an extremely amusing way, and is remarkable not only for its profound, and even disturbing, knowledge of the nature and origins of the different kinds of food that one can eat (though not necessarily digest), but also for its light touch.

On a bookshelf, it might sit between Huntington's "Civilization and Climate" on one hand and Prof. Saintsbury's "Notes from a Cellar Book" on the other. Perhaps it is the obvious fact that Mr. Boulenger has had a first-hand knowledge of so many of the things of which he writes that gives this book its freshness; perhaps it is also the restraint with which he makes scientific and historical facts amusing to the reader. You may be aware that ass's milk has medicinal qualities; or of the pull that is exerted by the suckers of an octopus; or that a load of Portuguese oysters was once wrecked off the mouth of the Garonne, and afterwards established a local colony there (one 'oyster park' now covering ten thousand acres). But if you know these commonplaces, you cannot at the same time also know who first started snail farms; or what Ahenobarbus said to Crassus in the Senate when Crassus wept publicly over the death of his favourite eel; or that Roquefort cheese is made from the milk of ewes, Gruyère from goats, and most other cheeses from cows; or that fat-tailed sheep were known to Aristotle, who referred to sheep with broad tails a cubit long.

(2) The second book is also about food, although one may not at first sight perceive this fact from its title and arrangement. The Carlsbad Cavern, a mammoth cave in the heart of the New Mexico desert, is inhabited by a vast colony of bats, which roost there at night in summer and hibernate here during the winter. The bats inadvertently covered the floor of the biggest cave with a layer of guano which was formerly about a hundred feet wide, a quarter of a mile long, and up to a hundred feet deep. The guano was removed after twenty years' hard work, and presumably made someone's fortune; but it soon began to accumulate again, at an estimated rate of about three-quarters of an inch per year. The guano supports a curious fauna, starting with cave-crickets, which are eaten by a cave species of deer-mouse (*Peromyscus*); while the mice are pursued and eaten by a kind of small carnivorous animal, the Ring-tailed Cave-cat (*Bassariscus astutus*). All these animals live in total darkness. There are other inhabitants of the cave, but they are mostly strays from the desert around.

The account of this cave fauna will be found in a rather scattered way throughout the book; for, in order to give a correct perspective, the author has devoted about three-quarters of the book to a description of the life-zones of the surrounding desert region, together with an account of all the species of mammals found there. The more important birds and reptiles are also mentioned. Most of these animals play no part at all in the ecology of the cave, and to this extent the title of the book is misleading. However, such a method of treatment is doubtless sound, and is certainly the best one for American readers, who may have an opportunity of actually visiting the region. For people who do not live in America, the chief interest of Mr. Bailey's book will centre round the cave and its animals, which form an extraordinarily interesting story (see pp. 69-70, 105-120, and 171-185).

(3) The example of the United States has now been followed by several other countries, which have started more or less systematic biological surveys. The third book, on the natural history of Canterbury, a region in the North Island of New Zealand, represents an effort to take stock of the present scientific knowledge of that region, in order that the results may be reviewed and future lines of research indicated. Since there are above twenty articles, by more than fifteen contributors, on a wide range of subjects, it is difficult to give here an adequate review of all the different lines of investigation. The subjects dealt with are as follows: biographies of men of science from the province; early history, exploration, and surveys; geology and palæontology; plant ecology and distribution; the fate of native and introduced animals (fish, birds, and agricultural stock); the history of zoological work; forestry; and agriculture.

Practically no attempt has been made to co-

ordinate these diverse paths of research; but this is perhaps not surprising, since scarcely anyone seems to attempt this anywhere. It follows that one cannot easily read this book without some special interest, such as a local knowledge of the place or the people concerned. All who are interested in New Zealand itself will find in these collected articles much to interest them; the general reader will scarcely find in it more than a very valuable work of reference on special points. On the biological side, which alone the reviewer is competent to assess, the parts of most general interest are the notes on native and introduced animals, and their interactions; and the notes on fossil birds by Mr. R. Speight.

(4) The recognition of the scientific importance of natural history often seems to pass through a series of cultural stages: first, private field naturalists with unprejudiced minds, working in isolation, secondly, natural history societies and zoological gardens, which start as a mixture of scientific interests and herd instincts, usually tinged with an educational bias. Stage three produces ecological surveys, run in different ways, according to the psychological habits of the country concerned. In the United States there are government surveys; in England, most of the work is done by private individuals or by professional workers co-operating with private naturalists. Stage four (seldom reached) is the eager co-operation of all people concerned, with the object of solving the urgent problems raised by variations in the numbers of injurious or beneficial animals. England has remained in stage two for about eighty years and is just graduating into three. It appears from Dr. Knottnerus-Meyer's book that Italy is just entering on the stage that we are leaving.

Books on zoos are usually of an extraordinarily sterile character, chiefly because they consist so largely of anecdotes about animals which, after all, are kept under very unnatural conditions. If we knew how they behaved in a wild state, we should have an interesting sort of controlled experiment; but as most of the inhabitants of zoos are there because they are hard to get, and still harder to study when they are wild, this advantage disappears. Another drawback to most books on zoos is the tendency to interpret the actions of animals in terms of human psychology. Dr. Knottnerus-Meyer, while avoiding the latter trap, cannot be wholly acquitted of the first charge, for a large part of the book consists of anecdotes of more or less interest. One might say that they hold the attention, but do not impinge on the intellect. At the same time, embedded in this lighter substance, there are a number of curious observations, which are difficult to fit into existing scientific theories, and therefore of value. For example, we learn that chloroform acts quickly on baboons, but has only a very small effect on lions and tigers; that camels always bite one another in the legs, and therefore kneel when fighting; and that "ostriches are seldom cordial in their relations to men": and so on. Perhaps the most interesting part of the book is the short introduction, in which Dr. Knottnerus-Meyer states his views on the psychology of animals. One also gets the point of view of a trained Prussian towards the Italian behaviour to animals.

CHARLES ELTON.

Mining Stratified Deposits.

The Working of Coal and other Stratified Minerals. By H. F. Bulman. (Benn's Mining Series.) Pp. 338. (London: Ernest Benn, Ltd., 1927.) 42*s.* net.

IT is difficult to select any other vocation into which so many branches of science enter as mining. Some subjects which originally were thought to be parts of mining are now complete courses of study in themselves, and there are many subjects necessarily grouped together to form a complete training for a would-be mining engineer, including a part of each one of the subjects withdrawn. Formerly, it was the fashion for writers of text-books on mining to try to give a comprehensive view of the subject as a whole, but such has been the growth of knowledge and inquiry in this direction, that it is now impossible to give more than a very elementary view in a single volume.

This is borne out by a series of books recently published of which the volume under review is one, in addition to a vast number previously published and those in preparation; each of these new books specialises on a single branch, or, in some cases, on a further subdivision of the branch. The book by Mr. Bulman is on methods of mining, the subject which forms the heart of the work of the mining engineer, and around which all the other branch subjects used to be arranged in the old comprehensive text-books, but it should be noted that it professes to deal only with stratified deposits, as against veins and deposits of mineral having no particular shape, known as masses; and even then it only does so incompletely.

The book contains the greatest number of ex-

amples of methods of mining stratified mineral deposits of any book yet written, but it covers so wide a field that the author has had difficulty in selecting the matter to be included from the large amount at his disposal. It follows that because the matter is technical in a high degree, and may only be read by persons closely interested, that it might lead an author into leaving too much to be assumed by the reader, but this has been avoided; much detail is given, and the importance has obviously been recognised of adequate illustration by means of line drawings in at least three most important planes.

There is an introductory chapter, followed by discussion of the diverse conditions met in practice, and 'opening-out,' in the two succeeding chapters. The matter of shaft pillars is dealt with in Chapter iii., where it will be found that the opportunity has not been taken to use this as an introduction to the most important subject of earth movements induced by removal of mineral. This portion of the work would produce sufficient matter for the making of a book of fair dimensions alone, so that although some students and engineers may be disappointed at the omission of what appears to be almost essential matter in a work of this kind, it may be that the author had good reasons for the treatment given.

Chapter iv. deals with development, Chapter v. gives an account of the support of the roof by means of packing with debris obtained underground, or in some cases sent from the surface, and Chapter vi. describes the packing of the goaf by means of waterborne material sent down from the surface. The costs of operation are added to the account of hydraulic stowing, thus enhancing its instructive value. From this point up to Chapter xii., methods of mining coal as carried out in Britain are given, clearly dividing the first twelve chapters into two parts. Between these two sections it is difficult to understand for whom the work has been written. The opening chapters seem to promise something useful for the student, but the inclusion of hydraulic stowing early in the book suggests a desire on the part of the author to help seniors in practice; and at other points it would seem to have been designed for the layman or novice. There is a paragraph on 'Bumps' on p. 146 which requires revision at the earliest opportunity.

Chapter xiii. is on methods of mining in the United States of America, and it ought to serve as a reminder that, having the premier coal output for the world, in the United States there must exist a vast amount of literature on methods of mining, which would certainly prove interesting to students of mining in Britain. Over there the much greater use of machinery in the actual mining entails the need for intensity of production, which has to be obtained with labour a large percentage of which does not speak the language of the country, and hence cost of supervision, always at a maximum with mechanical production, must be very high compared with Britain. The success of a method of mining depends on many things, and the more intensive it is, the better must be the lay-out of the workings: therefore, this might be a point at which something useful could be learned; though, on the whole, it is well known to British mining engineers that comparisons of the methods of the two countries from the economical point of view are scarcely possible on account of the difference of general conditions.

The inclusion of mechanical loaders in a separate chapter seems rather out of place, unless it be read as a continuation of American methods, for which there is justification in that the use of conveyor loaders and mechanical shovels underground is due largely to American engineers. Regarded as coal getting by machinery, it would appear to be very incomplete. Chapter xv. is on 'getting' the coal, and this chapter also cuts into the subject of the application of machinery at the coal face, in such a way as to suggest that it would have been better to have discussed coal cutting by hand, and then to have followed with a full account of the application of machinery at the coal face. Obviously, a book on modern methods of mining cannot ignore the application of machinery, so that a full account of coal cutters, conveyors, loaders, and mechanical shovels becomes essential.

The next two chapters deal with continental methods of coal mining and coal mining in South Africa, and they are followed by a chapter on the methods of mining the gold-bearing beds of the Rand. Each of these chapters opens up new and interesting ground for the average British mining engineer or student, who would do well to regard them as introductions to new ground, and not as completely organised accounts of the methods in use in those countries. Methods of mining coal in India are to be found in Chapter xix., but obviously the author has been hampered by the small amount of matter published, giving what might be termed the extraordinary methods rather than the usual everyday methods adopted in seams of about fifteen feet or less in thickness. Coal mining in Australia, methods of mining ironstone, Scottish oil shale mining, miscellaneous examples from various places,

and finally a chapter on quarrying, bring the book to a close. The final chapters should also be regarded as introductions to new branches of mining.

The author has attempted a difficult task, for he deals with many countries, and it is probable that a book could be written on mining stratified deposits in each of the countries mentioned without exhausting the subject, as might be shown by reference to the transactions of the mining societies of these countries. It would be possible to be critical on the score of faulty organisation of the matter, though in the chapters on British methods of mining there is systematic treatment. The treatment of this section would have been much improved by the introduction of a preliminary classification of the methods. It is a pioneer work, and should bring a large amount of information within the reach of many who are unable to obtain access to the sources of information available to the author.

C. HABBERJAM.

Our Bookshelf.

The Student's Guide to the Libraries of London: with an Account of the most Important Archives and other Aids to Study. By Reginald Arthur Rye. Third edition, revised and enlarged. Pp. xxv + 581 + 61 plates. (London: University of London Press, Ltd., 1927.) 10*s*. net.

THE material for the first edition of this handbook was collected in 1907 at the time when the Senate of the University of London was occupied with the task of organising, co-ordinating, and developing the libraries under its control. Accurate information was needed of the great resources offered by the libraries of the metropolis, and the small book of 76 pages published in 1908 was the first attempt to collect this information into a single volume. The present, much enlarged edition may be taken as some indication of the usefulness of the work.

Although probably no instruments are more essential than libraries to the advancement of knowledge, it is doubtful whether London was well provided with these necessary adjuncts to learning even in the eighteenth century. Thomas Carte, the historian, writing in 1747, said: "I am sorry to observe on this occasion that there is scarce a great city where learning is at all regarded, which is so destitute of a good publick library as London." Boswell's dictum in 1780 that "in London I suppose we may find every book that can be found anywhere" has certainly never been true; and although London is now probably better provided with libraries than any other great centre, their resources are sadly wasted for want of organisation, by restriction of access, or through ignorance of their existence. Most of those responsible for the six hundred and sixty libraries that have been considered sufficiently interesting to be included in this volume are working independently by multifarious systems to fulfil their individual aims, and there is no doubt that a great deal of money is spent on unnecessary duplication that might be laid out in procuring books that are not available in Great Britain. There are, moreover, too many indifferent or inferior libraries.

The volume before us offers a summary of the situation. The very interesting historical introduction begins with an account of the remains of the ancient libraries of Assyria, Babylonia, and Egypt; it traces the vicissitudes of libraries through the ages, and includes an account of many former London libraries which have now disappeared. Then follows a detailed account of existing libraries and an extensive index, which contains, besides the names of libraries and collections, the sources of information under the titles of their respective subjects.

S. C. B.

Buddhism in Pre-Christian Britain. By Donald A. Mackenzie. Pp. xx + 178 + 12 plates. (London and Glasgow: Blackie and Son, Ltd., 1928.) 10*s*. 6*d*. net.

WHATEVER may be the readers' verdict on Mr. Mackenzie's views, and we fear it will not be favourable, they will not be able to deny that he has written what is in many ways a fascinating and stimulating book. Starting from the records of Asoka's *Western* Buddhist Mission, of which the extent is questioned by authorities on Indian history, and Origen's attribution of a knowledge of Buddhism to Britain, which is equally held in doubt, Mr. Mackenzie analyses our knowledge of the pre-Christian Celtic beliefs and culture to show that they contain a large element which he attributes to Buddhism.

A great deal of the material on which Mr. Mackenzie relies for the details of his thesis is colourless in itself. It is drawn to a great extent from Irish sources. Perhaps nowhere in the world has native legend and belief been refashioned by extraneous ideas as it has in Ireland. This is shown, for example, by the frequent allusions in popular legend to distant lands by names which would come as a surprise when found among an uneducated people unacquainted with classical learning and tradition. Ireland was the land of learning as well as the land of saints, and further, the British Church was an Eastern Church, as was demonstrated in the opposition to the missionary efforts of St. Augustine. In Ireland, without question, some of the monkish learning filtered through to the people.

On the other hand, this much must be said in favour of Mr. Mackenzie's views—if once the major premise of the existence of Buddhism in Britain could be proved, his interpretation of extraneous matter of uncertain origin might be justified. His argument really depends upon two things, one that the Druidic theory of transmigration came from the east and was not really derivative from Pythagoras, and secondly from the representation of a horned god, whom he identifies as, and equates with,

Cernunnos, on the Gundestrup silver bowl, which he calls Celto-Buddhist. To this the critic might reply that the bowl is neither Celtic nor Buddhist, though on the face of it it appears to show Buddhist as well as other influences. Further, is this horned deity distinctively Celtic? His cult existed in remoter Germany, in Charlemagne's day, and goes back to palæolithic times. In dealing with the 'Isles of the Blest,' Mr. Mackenzie does not mention the persistent tradition of an early settlement of Irishmen in Middle America.

Elements of Optical Mineralogy: an Introduction to Microscopic Petrography. By N. H. Winchell and A. N. Winchell. Entirely rewritten and much enlarged by Prof. Alexander N. Winchell. Second edition. Part 2: *Descriptions of Minerals, with Special Reference to their Optic and Microscopic Characters.* Pp. xvi + 424. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 27*s.* 6*d.* net.

THE descriptive part of Winchell's "Optical Mineralogy" has been completely rewritten and much enlarged to form the second edition. With the exception of a few of the commoner opaque minerals, there are included only natural species the optical properties of which are sufficiently well known to permit their identification microscopically. The arrangement of the minerals has been changed, and the system now adopted is the familiar scientific classification of Dana, modified to some extent by advancing knowledge. Certain of the names used are rendered unfamiliar by the adoption of the termination '-ite'; for example, chrysotilite for chrysotile. No difficulties arise through such changes, however, owing to an adequate index, which includes synonyms.

An excellent feature of the work is the large number of diagrams, 333 in number, used in explaining the optical and chemical properties of the minerals. The description of very many mineral species is accompanied by a simple diagram to illustrate their optical orientation. In addition, there are many more complex figures showing the variation in chemical composition, and the relation between chemical composition and optical properties in different mineral series. Most of the new information is expressed by means of these diagrams, and a useful introductory chapter is devoted to an explanation of their mode of construction and uses. A small number of rather poorly reproduced photomicrographs of thin slices of minerals is included. The treatment of the more important rock-forming minerals is very full, that of the felspars, for example, occupying 64 pages.

The comprehensive and up-to-date nature of the work is indicated by the many references to original sources of information. The European and American literature appropriate to the subject appears to have been very thoroughly, if not quite exhaustively, searched. No determinative tables are included, but the book can be recommended as a work of reference for advanced students and research workers in petrography and mineralogy.

V. A. E.

Steel and its Heat Treatment. By D. K. Bullens. Third edition, rewritten and reset. Pp. xii + 564. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 25*s.* net.

THE third edition of this well-known treatise has been greatly improved, and it is now almost indispensable to the steel metallurgist, on account of the detailed records of the heat treatment and properties of a very wide range of industrial steels which it contains. The specifications under which the steels are grouped are mainly those of the American Society of Automotive Engineers, but it is not difficult to correlate them with the corresponding specifications used in Great Britain. English readers will find a greater obstacle in the fact that all stresses are expressed in pounds (instead of tons) per square inch and all temperatures on the Fahrenheit scale, and it could be wished that an English edition might be prepared in conformity with metallurgical practice in Britain. However, a table of equivalents can always be kept at hand when the book is consulted, which is likely to be frequently. A new chapter on electric furnaces for heat treatment is included, and will prove of special interest, as it is not generally known that such furnaces have come extensively into use in the United States, in spite of the increased cost of operation. This section, which is fully illustrated, is very valuable. The theoretical side of the subject receives much less attention than the practical, but the microscopic structure is fully discussed, the photographs being good and in some instances excellent. It may be remarked that the wonderful properties of zirconium steel, of which much was heard during the War, have proved to be mythical, and the paragraphs which the author quotes from two cautious investigators, proving a certain effect in removing impurities, represent the truth concerning this element much more closely than the exaggerated statements which have sometimes appeared.

Glasgow: Sketches by Various Authors. Edited by J. Graham Kerr. General Handbook of the British Association for the Advancement of Science, Glasgow Meeting, 1928. Pp. x + 357 + 12 plates. (Glasgow: Local Committee of the British Association, 1928.)

THE handbook for this year's meeting of the British Association is a modest volume compared with that issued on the occasion of the last meeting at Glasgow twenty-seven years ago. It consists of a series of essays by various authors on different aspects of the city, among which education has considerable space. The chapters on the city and on the harbour have particular value in tracing the growth of Glasgow and its activities. There are essays on the geology, fauna, and flora, but no attempt is made to deal exhaustively with these subjects. The absence of the floristic and faunistic lists, which used to be a feature of British Association handbooks in the past, is welcome, but an introductory chapter from the geographical point of view might well have been added. Topographical and geological maps are given in a separate cover. These are on a scale of one inch to a mile.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Negatively Modified Scattering.

IN a paper published in 1923, Einstein and Ehrenfest discussed the general problem of thermodynamical equilibrium in an assembly traversed by light, which is subjected to scattering by the particles of the assembly. They deduced, in a way (which is quite analogous to Einstein's famous deduction of the laws of black body radiation by consideration of thermodynamical equilibrium in the presence of Bohr-type of vibrators), that the excited particles of the system would give rise to a type of modified scattering analogous to Einstein's negative absorption. Smekal pointed out in a letter to *Naturwissenschaften* (1923) that if light of frequency ν is scattered by the particles of the assembly, then in addition to unmodified scattering of frequency ν, scattered light should also consist of light of frequency $\nu + \nu_k$, $\nu - \nu_k$, where $h\nu_k$ is the energy difference between the excited state and the normal state of the scattering particles ("Handbuch der Physik," Bd. 23, pp. 93-99).

This last prediction has been very brilliantly confirmed by Raman and Krishnan, who exposed liquid benzene to the monochromatic mercury radiation $\lambda 4358$, and on examining the spectrum of the scattered light found modified scattered light of frequencies $\nu + \nu_k$ where ν_k is any one of the fundamental frequencies of liquid benzene. We wish to point out that Raman and Krishnan's experiment is not, strictly speaking, a confirmation of Einstein's negative or stimulated emission, as mentioned by these authors (NATURE, June 30, 1928), but of the analogous case of negatively modified scattering (that is, scattering of light of frequency $\nu + \nu_k$) discussed by Smekal.

We wish further to point out that the theory of modified scattering affords a very simple and convincing explanation of the phenomena of resonance spectra of vapours of sodium, potassium, and the halogens discovered and so elaborately described by R. W. Wood in his numerous papers. He found that when vapour of these substances is illuminated by monochromatic light (lithium, cadmium, bismuth, or zinc arc), then the vapour emits laterally a partially polarised spectrum consisting of the original line, and a number of fine lines spaced at equal frequency intervals (of about 145 in the case of Na). The position of these excited lines in the spectrum depends upon that of the exciting light, though the frequency interval between the exciting line and its adjacent excited light is independent of the exciting frequency for the same substance. The remarkable fact is that there are also a number of lines on the shorter wavelength side of the exciting light, which have been styled by the German authors (Pringsheim and his students) the 'anti-Stokes'' lines. These anti-Stokes' lines also show equal spacing, and they can be explained as being due to negatively modified scattering.

Pringsheim and his students have shown that the sodium vapour contains temporary Na_2 molecules and gives rise to banded spectra on excitation. One of the strongest vibration frequency intervals is $\Delta\nu = 145$, which may be identified with the frequency of one of the fundamental modes of vibration of the component atoms. So the explanation of Wood's resonance spectra becomes evident now. When the exciting light traverses Na_2 molecules, the light is scattered by them, the scattered light having the frequencies $\nu \pm \nu_k$ where $h\nu_k$ is the energy difference between any excited state and the normal state of the Na_2 molecule; the excitation not involving any electron displacement, but being due only to the vibration of the component atoms which are easily produced under moderate heating. The plus sign refers to the negatively modified scattered light and accounts for the anti-Stokes' lines. Similar explanations hold good for the resonance spectra of K_2 and the halogens. These substances alone have been shown to be capable of giving rise to resonance radiation, as the molecules can be easily excited to higher vibration frequencies. But it can presumably be proved to be a general phenomenon in the case of all molecules.

We wish further to point out that though the phenomenon has been described as one of 'scattering,' it seems to be intermediate between pure scattering (as by fog-particles in which the agent responsible for scattering does suffer no physical change) and pure absorption (as, for example, the absorption of the sodium line by the sodium atom, resulting in the utilisation of the total energy of the energy-particle in lifting the electron to the higher orbit and production of a new system). This phenomenon is just intermediate between the two, as the incident light reacts on the particle, and robs it of its internal energy and is re-emitted as a new radiation of increased frequency.

It seems that the polarisation of the secondary rays is probably only a time effect, depending upon the intimacy of the reactions taking place between the incident light and the scattering particle. Therefore in pure scattering, the scattered light should be completely polarised in pure absorption and in re-emission unpolarised; and in phenomena intermediate between these two it should be partially polarised, as has been proved by Wood.

The phenomena of negative scattering should also be capable of extension to free electrons, and will thus probably afford an easy explanation of the origin of bright and broad bands in the spectra of Novæ, and of winged lines in the solar spectrum.

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The Scattering of Light by Free Electrons according to Dirac's New Relativistic Dynamics.

DIRAC and Gordon have given a quantum-dynamical treatment of the problem of the scattering of light by free electrons which seems to be in good agreement with experimental results. Since the development due to Dirac of a more rational relativistic dynamics of the electron, which automatically takes the so-called 'spin' phenomena into account, the basis of the theory of the intensity and polarisation of the Compton scattering is, however, somewhat modified. We have undertaken a calculation, based on the new theory, of the intensity of the light scattered by an electron under the influence of a plane monochromatic wave train. When the incident radiation is unpolarised—a case where the least deviation from the former theory would be expected—our result can be expressed by the following formula:

$$I = I_0 \frac{e^4}{2m^2c^4r^2} \Bigg[\frac{(1+\cos^2\theta)}{\left\{1 + \frac{h\nu}{mc^2}(1-\cos\theta)\right\}^3} + \left(\frac{h\nu}{mc^2}\right)^2 \frac{(1-\cos\theta)^2}{(1+\cos^2\theta)\left(1+\frac{h\nu}{mc^2}(1-\cos\theta)\right)} \Bigg] \qquad (1)$$

Here I is the intensity at the distance r from the electron of the light due to a Compton process, where the secondary light quantum is emitted in a direction forming an angle θ with the incident beam of intensity I_0 and frequency ν. Further, e and m denote charge and mass of the electron, c the velocity of light, and h the Planck constant.

Formula (1) is seen to differ from the corresponding formula of the earlier theory by the last factor $\left(1+\left(\frac{h\nu}{mc^2}\right)^2\frac{(1-\cos\theta)^2}{(1+\cos^2\theta)\left(1+\frac{h\nu}{mc^2}(1-\cos\theta)\right)}\right)$, *i.e.* the deviations between the two formulæ are of the order $\left(\frac{h\nu}{mc^2}\right)^2$, while the earlier expression differs from the classical expression given by J. J. Thomson by quantities of the order $h\nu/mc^2$. In the case $\frac{h\nu}{mc^2}=1\cdot1$, corresponding to a wave-length of 0·022 A., where

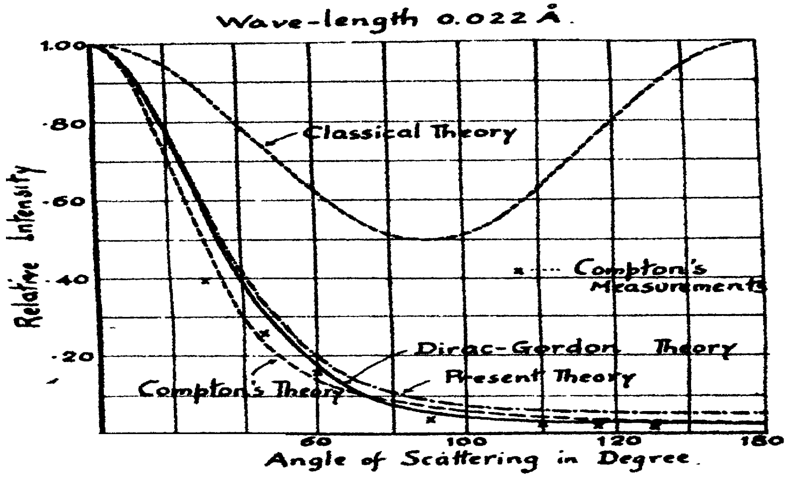

FIG. 1.

Dirac has compared his formula with the measurements of Compton, however, the deviations at the larger angles are not small—though perhaps within the experimental uncertainty—as shown by the above reproduction of Dirac's figure, where the —·—· curve corresponds to formula (1). The maximum deviation, which occurs near 125°, amounts to 82·5 per cent of the value obtained from the Dirac-Gordon formula.

From formula (1) we get the following expression for the scattering coefficient s, due to Compton effect, of a substance containing N electrons per unit volume:

$$s=\frac{2\pi Ne^4}{m^2c^4}\left\{\frac{1+\alpha}{\alpha^2}\left[\frac{2(1+\alpha)}{1+2\alpha}-\frac{1}{\alpha}\log(1+2\alpha)\right]+\frac{1}{2\alpha}\log(1+2\alpha)-\frac{1+3\alpha}{(1+2\alpha)^2}\right\}, \quad (2)$$

where $\alpha=h\nu/mc^2$. Here the last two terms $\frac{1}{2\alpha}\log(1+2\alpha)-\frac{1+3\alpha}{(1+2\alpha)^2}$ are absent from the corresponding expression given by Dirac. They mean again a deviation from the earlier theory of the order $(h\nu/mc^2)^2$. In fact, formula (2) for values of α small compared to unity gives

$$s=\frac{8\pi}{3}\frac{Ne^4}{m^2c^4}\left(1-2\alpha+\frac{26}{5}\alpha^2\right), \quad . \quad . \quad (3)$$

while Dirac's expression with the same degree of approximation gives

$$s=\frac{8\pi}{3}\frac{Ne^4}{m^2c^4}\left(1-2\alpha+\frac{21}{5}\alpha^2\right). \quad . \quad . \quad (4)$$

For $\alpha=1$ the deviation between the two theories is considerable, formula (2) giving a value about 50 per cent higher than that of Dirac. But for α small compared to unity they are seen to deviate very little from one another; already for $\alpha=\frac{1}{2}$ the deviation is only about 10 per cent.

A detailed account of the calculations also including the question of polarisation is under preparation.

Note added in Proof.—Since the above was written, we have considered the question of the comparison of the theory with the experiments more closely. Indeed, from recent experiments, it would appear that ascribing a wave-length 0·022 A. to the γ-rays from RaC, with which Compton's experiments were made, is scarcely justifiable for this purpose; the radiation in question being very complex with an average wave-length of only about half the above value. If this complexity is taken into account, the comparison of Compton's measurements with the theoretical formulæ comes out very differently; and formula (1) is found to agree with the measurements rather better than that of Dirac and Gordon. The experiments, however, seem too uncertain to decide between the two formulæ. In this connexion we should like to direct attention to the possible bearing of our calculations on the estimation of the wave-lengths of the cosmic penetrating radiation. In fact, if formula (2) is used for the calculation of the absorption coefficient, the wave-lengths obtained for the cosmic rays are considerably shorter than those ordinarily assumed.

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The Definition of 'Area' in the Case of Contact Catalysts.

As has already been pointed out (*Proc. Roy. Soc.*, A, vol. 119, p. 196; 1928), the area of an activated contact catalyst will vary with the method of measurement adopted. It is thus essential to the precise development of the methods of measuring area that the maximum area of a surface should be defined carefully, so that the results of all measurements may ultimately be compared with this standard.

The surface itself consists of atoms or molecules, continually in vibrational motion, having mean positions which are fixed. A minute investigation summing the area over each surface atom is valueless. For the purposes of physical chemistry the area of the envelope touching all atoms in the surface might be thought a good definition; but chemical reactions on contact catalysts mostly take place in a unimolecular film of absorbed gas molecules distributed over the surface; so that a knowledge of area is most valuable for the calculation of the maximum number of molecules of any given type that could be closely

packed in a unimolecular film over the rugged activated surface.

Since the smaller the adsorbed atom or molecule the more likely it is to fit into the smallest irregularities, a surface will appear to have its maximum area when covered by hydrogen atoms all in contact with each other, and with the catalyst surface. This conclusion is reached upon geometrical grounds simply. The maximum area of a contact catalyst for physical chemical purposes is the area of the envelope of the unimolecular film of hydrogen atoms closely packed, all in contact with each other, and with the catalyst surface, which completely cover it.

If the adsorbed molecules are large, then the area of a very irregular surface measured by the number of adsorbed molecules will appear to decrease, but the area of a plane surface will remain unchanged. There seems to be little meaning to be attached to the term 'true' surface, for each of various methods of measurement will give a correct result, but these results will be all different. At the present time it seems best to define the 'maximum' area of a surface as the envelope of hydrogen atoms covering it completely with a unimolecular film, because this gives as near as possible an absolute definition.

The measurement of this maximum value is a matter of great difficulty. One is faced with the heterogeneity of the adsorbing surface. The values obtained for the surface area of reduced copper by the interference method (cf. *Proc. Roy. Soc.*, A, vol. 115, p. 570; vol. 117, p. 376; vol. 119, p. 196), and from the quantity of hydrogen adsorbed at saturation at 0° C. are very nearly the same, in spite of the fact that the thickness of the film covering the copper is 10^{-5} cm. in one case and 10^{-8} cm. in the other. This confirms what is evident from the investigations of Pease, that portions of the surface do not adsorb hydrogen at all at 0° C. Thus the adsorption of hydrogen in this case gives no measure of the maximum area.

I have remarked that it seemed possible that an electrolytic method of deposition of hydrogen from solution might be used to measure this 'maximum' area of a catalyst; but that there was difficulty in obtaining experimental evidence of the completeness and unimolecular character of a film of hydrogen deposited by this means (*Proc. Roy. Soc.*, A, vol. 119, p. 197; 1928). This remark has been assumed by Bowden and Rideal to refer to their method (cf. *Proc. Roy. Soc.*, A, vol. 120, p. 89, Aug. 1928); but this is evidently not the case, since they state that they are measuring the 'accessible' area of the surface to hydrogen ions which cover only a fraction of the 'maximum' surface. With considerable experimental and technical skill, using an Einthoven string galvanometer with a camera, they have followed the changes of potential of platinum, silver, and mercury in $N/5$ sulphuric acid against saturated calomel electrodes, when very small quantities of electricity were passed. They found that the relation between the quantity $\Delta\Gamma$ of the deposited hydrogen and the increase in electrode potential E was

$$\frac{\Delta E}{\Delta\Gamma} = K$$

for liquid mercury, where K was independent of the area of the cathode, current density, time of electrolysis, and strength of solution. With platinised mercury, and silver amalgam, they found K suffered little change, and generalised that if the surface were plane, K was independent of the chemical nature of the underlying metal. With etched or polished metals a considerable decrease in the factor K occurred. They then state that if A is the factor by which the plane area must be multiplied to give the irregular area accessible to hydrogen ions, the new relation applying to this case is (loc. cit. p. 72)

$$-E = \frac{K\Gamma}{A} + \text{const.}$$

or

$$-E = \beta\Gamma + \text{constant},$$

where $\beta = K/A$ and is a constant, and is the same for all metals, and Γ is called by Rideal and Bowden the 'true' surface concentration of the added hydrogen.

The direct assumption is thus made that the quantity β is independent of both (*a*) the chemical nature, and (*b*) the physical state of the minute structure of the surface. The latter assumption, which is fundamental, is very difficult of experimental proof, and is contained in all calculations of area by this method. The method is therefore empirical. The standard value of $\beta = \frac{K}{A}$ was obtained from a mercury surface, assuming $A = 1$.

I think it probable that the method of Bowden and Rideal (assuming the truth of the fundamental assumption) would give results less than the maximum area as here defined, owing to the sparseness of the atomic layer of hydrogen used.

The interference method that I have been using disregards inequalities in the surface of magnitude smaller than 10^{-5} cm., and so gives results less than the 'maximum' area, and also less than Bowden and Rideal's results.

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The Estimation of Bacterial Numbers in Soil by Direct Counts from Stained Films.

THE method now in common use for determining the number of bacteria in soil by colony counts admittedly provides an estimate of only a small fraction of the total numbers in the soil, since any one medium will enable only a few of the physiological groups of the bacterial population to develop. The method of direct counts of bacteria in films of the actual soil was rendered possible by the development of a suitable staining technique by H. J. Conn and by S. Winogradsky. Both these workers have suggested methods by which estimates of the bacterial numbers in a soil sample can be made.

The method of H. J. Conn consists in diluting a given mass of soil to a known degree and spreading 0·01 c.c. of this suspension on a slide over an area of 1 sq. cm. The film is then stained and, from counts made from a number of microscope fields, the bacterial numbers are estimated. An important factor limiting the accuracy of such determinations would appear to be the difficulty in obtaining an accurate sample of a suspension of soil particles only 0·01 c.c. in volume. S. Winogradsky estimates the mass of soil in his films by weighing. Here the difficulty in obtaining accurate weighings of such small masses of soil would seem to limit the accuracy of the method. In both methods the bacterial numbers are actually based on counts from random microscope fields.

G. Kühlmorgen-Hille found that these two methods gave widely different results. The main sources of error would appear to be, first, that of determining accurately the mass of soil in the film examined, and secondly, the implied assumption that the bacteria are distributed at random over the film from which sample fields are taken. Kühlmorgen-Hille's data, when tested by the χ^2 index of dispersion, show that the distribution of the bacteria is not random.

We have tested a method in which both of these

difficulties are avoided, by determining, in random microscope fields from a parallel series of stained films, the ratio between the number of bacteria and the number of particles of indigotin, a counted suspension of which has previously been added to a given mass of the soil. The ratios thus obtained from parallel fields are found to be distributed at random, and the bacterial numbers calculated therefrom are of course independent of the amount of soil in the film.

The following is a description of the method tested by us. A suspension of indigotin in distilled water is sterilised and the number of particles per c.c. counted on a hæmocytometer by means of a high-power water-immersion objective. 5 grams of the soil are shaken for three minutes in 25 c.c. of this standard indigotin, and further shaken for one minute after the addition of an equal volume of sterile 0·01 per cent agar. From each soil to be examined three or four parallel slides are made, each having four or five small drops of soil-indigotin-agar suspension, applied by means of a mapping pen. The suspension is shaken between the application of successive drops and the slides placed immediately under a damp cover for a few minutes. The films are dried and placed for 10 minutes in a bath of carbol-erythrosin (1·5 gm. erythrosin; 5 gm. phenol; 100 c.c. water; filtered before use); washed in a bath of distilled water; stained for 10 minutes in 2·5 per cent aqueous erythrosin; washed in distilled water, and dried. Bacteria and indigo particles in four to eight random fields from each drop are counted. The ratio of bacteria to indigo is thus obtained, and since the absolute number of indigo particles is known, the number of bacteria per gram of soil can be calculated.

The accuracy of the method has been tested in the following experiments:

(i) A known number of cells of an organism were added to sterilised soil and estimated to within 1 per cent.

(ii) The bacterial numbers in four portions of the same soil sample agreed within a standard error of 5 per cent.

(iii) In all tests the deviations observed between parallel drops were within expectation based on random sampling, and can be brought down to a standard error of 2·5 per cent by counting sufficient fields.

(iv) The numbers found by two workers counting independently in test (ii), and

(v) The numbers found in films prepared by three workers from the same soil sample, showed no significant differences.

A full description of the method and the results obtained will be published elsewhere.

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Aug. 22.

Cress Grown on Adrenaline.

A FEW preliminary experiments relating to the action of the internal secretions of animal glands upon vegetable life have yielded a somewhat extraordinary result with adrenaline. Cress seeds grown on pads of cotton wool soaked in 1 in 10,000 solution of adrenaline showed the following marked differences from control crops grown on distilled water.

(1) The seeds germinated later, and there was a retardation of approximately twenty-four hours.

(2) After the preliminary retardation, growth advanced at a rapid rate, and within three days the plants were considerably taller than the controls.

(3) When maturity of growth was reached the plants were much taller, and the leaves larger than the controls. Also, the plants were a paler shade of green.

(4) The most striking feature was the presence of adrenaline, or adrenaline-like compounds, in the 'heads' of the cress. It is important to note that no adrenaline was added after the initial dose, and the wool pad kept moist with distilled water. The plants were continuously exposed to the air and light.

After carefully washing the cut 'heads' of the plants they were reduced to a paste with distilled water, and the fluid filtered and tested for adrenaline. A deep rose pink colour was obtained with the iodine test and other oxidising tests for adrenaline. The control cress entirely failed to show any of these reactions.

Some of the cress was extracted with normal saline and injected into decerebrate cats. Typical adrenaline curves were obtained, and it has been possible to demonstrate all the pharmacodynamical reactions of adrenaline in the cress.

(5) The cut ends of the stalks show a distinct tendency to bud.

Tests of the cotton wool pads at the time of mature growth failed to reveal the presence of adrenaline even in minute amounts. It therefore is suggested that the cress in some manner either produces a stable form of adrenaline, or manufactures an adrenaline-like compound which is stable.

Moreover, it appears to be probable that the cress synthesises adrenaline, or a similar compound, from the products of the oxidation of adrenaline.

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The Crystalline Structure of Benzene.

BY means of X-ray measurements upon single crystals, using the rotation method, I have been able to determine the unit cell of benzene. The cell is simple orthorhombic, of dimensions $a = 7{\cdot}44$ A., $b = 9{\cdot}65$ A., and $c = 6{\cdot}81$ A. at $-22°$ C., and contains four molecules. As a result of the examination of about one hundred crystal planes, the space group was found to be $Q^{15}{}_{h}$ (orthorhombic bipyramidal). From this it can be shown that *in the crystal* the molecule has a centre but no planes of symmetry. Taking a standard molecule at a corner of the cell, the three derived molecules are situated at the centres of the cell faces. This pseudo-face-centred arrangement accounts both for the fact that the plane (111) gives the strongest X-ray reflections, and also for the bipyramidal habit of benzene crystals.

The cell now determined has axial ratios 0·771 : 1 : 0·704. Using the powder method, Eastman (*J.A.C.S.*, **46**, 917; 1924) obtained the values 0·775 : 1 : 0·725, while Broome (*Phys. Zeit.*, **24**, 124; 1923) found the ratios 0·763 : 1 : 0·700. Mark (*Ber.*, **57**, 826; 1924) measured the c-axis, and obtained a value between 6·8 and 6·9. He inferred from his measurements that the space group was either $Q^{11}{}_{h}$, $Q^{15}{}_{h}$, or $Q^{16}{}_{h}$.

Further work is in progress with the view of determining the remaining variables in the structure.

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The Archæology of Scotland.[1]

By Sir GEORGE MACDONALD, K.C.B.

THE first movement towards an organised study of Scottish antiquities dates from the last quarter of the eighteenth century. The Society of Antiquaries of Scotland was founded in 1780, and with it there came into existence what is now the National Museum. The leading spirit in the enterprise was David Erskine, eleventh Earl of Buchan. If we may trust Sir Walter Scott, who characterised him as "a person whose immense vanity, bordering on insanity, obscured, or rather eclipsed, very considerable talents," Lord Buchan was not altogether a promising sponsor for the infant science. But at this distance of time we may forgive his eccentricities and honour his memory for the substantial service which he rendered to our common cause.

In point of fact, it was probably the first president's very vanity, so severely stigmatised by Scott, that inspired William Smellie to produce his full contemporary 'Account' of the origin of the Society and its Museum with a list, or rather lists, of acquisitions. Lord Buchan's speeches and letters, which are there to be found verbatim, show plainly how limited was the archæological horizon of the age. Thus in his inaugural address, which maps out the field of the new Society's activities, he states explicity that the starting-point must be "the period of the Roman attempts to subjugate the northern parts of Britain." The monuments which we call prehistoric, but which in those days were called Druidical, "the Cairn, the Mount of Earth, Four Gray Stones covered with Moss"—I am quoting his own words—he attributes to the time of Ossian, and Ossian and his heroes he supposes to have lived in the reign of Caracalla. It is quite consistent with such a perspective that, after a gift of twenty pounds in cash, the first recorded donation to the Museum should have been "a quantity of Roman arms, consisting of twenty-three pieces of the heads of hasta and jaculum, twenty pieces of the blades, and nine of the handles of the gladius and pugio; a ring, three inches in diameter, fastened to the end of a staple; and a mass of different pieces of these arms, run together by fire, all of brass." It is not easy to realise that the objects masquerading in this classical garb are the contents of the well-known Bronze Age hoard which was dredged from the marl at the bottom of Duddingston Loch. Bronze Age weapons, indeed, are systematically labelled 'Roman' in the official record. Nor was it only to weapons that the epithet was applied. The relics of a Bronze Age interment figure as "an antient sacrificing ax of Roman brass . . . antient Roman cinereal urns . . . and pieces of burnt Roman bones." That is typical. The men of the Stone Age fare even worse. One or two perforated axe-heads of stone do appear in the catalogue, but they stand cheek by jowl with *lusus naturæ* like "a chicken preserved in spirits, having two heads conjoined laterally at the back of the skull." They are entered, too, under the old-fashioned name of "purgatory hammer," an echo of the popular belief that the purpose of placing such objects in graves was to equip the spirit of the dead with an instrument which should be sufficiently heavy to ensure a prompt response to his knocking at the gate of the after-world. Yet, despite the quaintness of these first beginnings, the institution thus cradled has developed, within a century and a half, into one of the finest archæological collections in Europe. The Earl of Buchan and his friends had builded better than they knew.

The story of our National Museum of Antiquities is a parable. It reflects the process by which, in every European country, the dilettante was transformed into the scholar, the antiquary into the archæologist. There are no general features which can be said to be peculiar to Scotland. *Honoris et pietatis causa*, however, mention must be made of one conspicuous figure. In retrospect, Dr. Joseph Anderson towers head and shoulders above the whole of his contemporaries. He was in charge of the National Museum for the long period of forty-three years, and the present collections are, in large measure, the fruit of his energy and discriminating zeal. But he did much more than merely stimulate their growth. He used them as material for that invaluable compendium of Scottish archæology which he embodied in his successive series of Rhind Lectures, the first of which was delivered so long ago as 1879. The intervening period has added much to our knowledge, so that, in the light of the fresh information now available, the details require to be corrected here and there. More frequently they merely require to be supplemented.

The pre-history of Scotland has much in common with the pre-history of other areas; but the country also contains groups of monuments and classes of archæological objects to which no parallel can be adduced from any other part of the world. Scotland, in a word, has an archæology of its own. The Scottish brochs, for example—those strange towers of dry-built stone with chambers in the thickness of the wall and no opening towards the outside save a very narrow doorway—are peculiar to the area. Scarcely less characteristic is one of the principal varieties of Scottish earth-house. Similarly the so-called 'Pictish' symbols on the sculptured stones stand quite alone, as do the heavy silver chains on which they occasionally appear, and the massive bronze armlets and carved stone balls of a somewhat earlier age.

Finally, as regards the archæological material generally, Scotland enjoys in one important respect a distinct advantage over her southern neighbour. Her medieval monuments may always have been relatively few and inconspicuous. Certainly her castles and her abbeys and her cathedrals have too often suffered grievously from hands that were

[1] From the presidential address to Section H (Anthropology) of the British Association, delivered at Glasgow on Sept. 10.

bent on malicious and wilful destruction. But her prehistoric remains are extraordinarily numerous and, ruinous as the condition of many of them is, they are not seldom sufficiently well preserved to offer a rich field for scientific investigation.

The first thing needful is a proper survey of the ground. That is being carefully, if slowly, carried out by the Ancient Monuments Commission, which has already dealt with several of the districts that are of most interest to the student from the prehistoric point of view. The reports on Sutherland, Caithness, Galloway, Skye, and the Outer Isles have all been published. Orkney and Shetland are under examination now. Argyll and Bute, Aberdeen and Kincardine, Peebles and Roxburgh will follow in due course. When these have been completed, a long step forward will have been taken. But something more than a proper survey is required; it should be accompanied by systematic and well-directed excavation.

It has been calculated that in Aberdeen and Kincardine alone there are some 200 stone circles. These, of course, are of the Bronze Age. Equally worthy of note is the abundance of remains belonging to the Early Iron Age. Thus the Inventories of the Royal Commission actually register as many as 67 brochs in Sutherland and no fewer than 145 in Caithness. If the pottery and chambered cairns of the Neolithic Period are less spectacular, they are scarcely less remarkable. In a word, it is not open to doubt that, in the days before history began, the north of Scotland and the Western and Northern Islands carried a population that was relatively very numerous. The contrast with the scene of desolation which they now present is often very striking.

The solitude of to-day is easy enough to understand. It is the density of population in prehistoric times that calls for explanation. I believe that the key will be provided by geography. That means distribution-maps. As yet our supply of these is far from adequate. Imperfect as it is, however, it may prove sufficient for our present purpose, more especially as we can fortify ourselves by an appeal to the sister-science of history.

Nowadays the vast majority of those who invade the Highlands and Islands approach them by way of southern and central Scotland. In prehistoric times that avenue was barred. The Caledonian Forest, which spread far southwards into what we regard as the Lowlands, must have been an impenetrable obstacle. The early immigrants arrived by sea and reached the mainland via the Western Islands. This implies that they came from Ireland, and that it is in Ireland that the roots of Scottish prehistoric civilisation must be studied. At the moment, however, we are concerned not with studying the roots, but merely with establishing a connexion between them and the full-grown plant. In other words, all that is necessary is to satisfy ourselves as to the set of the current of migration. It is significant that so late as the dawn of the historic period it was flowing strongly towards the north and east. The Scots themselves were, of course, incomers from Ireland and, if we can trust Continental analogies regarding the movement of peoples, we may assume that the foundation of the kingdom of Dalriada was preceded by a prolonged process of gradual infiltration. I have more than a suspicion that the troubles which the Romans experienced, and in particular the restlessness which compelled them to abandon the Forth and Clyde wall, were in no small measure due to the encouragement which the turbulent natives received from the passage of a steady stream of reinforcements across the narrows of Stranraer.

The case for migration from Ireland in prehistoric times rests upon a basis more stable than analogy. Further excavation and an ampler supply of distribution-maps are needed to make it complete, particularly for the Neolithic Period. The evidence however, is already considerable enough to furnish what may perhaps be accepted as convincing proof. Some years ago Mr. A. O. Curle, in his Rhind Lectures, directed attention to the testimony supplied by cup-and-ring markings. Such markings are recorded as occurring in twenty counties—Wigtown, Kirkcudbright, Roxburgh, Berwick, Ayr, Bute, Argyll, Dumbarton, Lanark, Mid and West Lothian, Peebles, Fife, Clackmannan, Perth, Forfar, Ross, Aberdeen, Sutherland, and Caithness. The Royal Commission's survey of North Uist and Benbecula enables us to add Inverness to the list. But, for the proper interpretation of the record, Mr. Curle went on to say, we must have regard to the number of examples that have been noted in each of the various countries. The poverty of the three shires that march with England—Berwick a single example, Roxburgh two, Dumfries none at all—precludes the idea that the folk responsible for these mysterious sculpturings entered Scotland by crossing the border. On the other hand, the area in which the markings are found in greatest number and with the greatest variation of device and complexity of design, is exactly the region that lies over against Ireland—the coastal districts of west and south-west Scotland. They abound in Wigtown and Kirkcudbright, and are still more common in Argyll. As they are also frequent in Ireland, the inference seems plain.

Cup-and-ring markings, in Scotland at least, must be associated with the phase of culture that was distinguished by the use of bronze. To discover what happened during the phase that succeeded it, we may turn to the brochs. At the outset it has to be admitted that the broch was not imported from Ireland. There are no brochs in Ireland. The broch is a purely Scottish creation, evolved on Scottish soil. Nevertheless, it is scarcely possible to doubt that it was from the shores of Ireland that the ancestors of the broch-builders originally came. They certainly did not make their way into Scotland across the border, any more than did the men who carved upon the rocks those mysterious cups and rings. There are no brochs at all in Dumfries or in Roxburgh. It is true that Berwick, Selkirk, and Midlothian

significant. The three sporadic examples I have named seemed to show the characteristic features of this type of structure already fully developed. The broch did not spring full-grown from the brain of some architectural genius of the prehistoric period; it was the outcome of a slow process of evolution. The southern brochs can only have been built by intruders from the north.

We may go further. Seventeen or eighteen years ago, in surveying Sutherland and Caithness for the Royal Commission, Mr. Curle noted certain points which seemed to him to indicate a gradual improvement in the type as one moved inland from the western coast, and he saw in this—rightly, as I think—a clue to the drift of the population. His deduction has received remarkable confirmation from the Commission's recently published survey of Skye and the Outer Isles, as well as from the late Dr. Erskine Beveridge's investigations in Tiree. In the insular region we find brochs in reasonable abundance—44 are recorded there by the Royal Commission—but we also find numerous specimens of what can best be described as the broch in the making. The so-called 'semi-brochs' of Tiree, the 'galleried duns' of the Hebrides and Skye, all alike appear to represent experiments in the architectural form which was destined to have its fullest expression on the mainland. As the broch-builders moved farther north and then farther east, they carried with them the fruits of their ripening experience.

The facts of early Scottish history and the inferences as to the Bronze Age and the Early Iron Age are thus in complete accord. They bear out the view—in itself *a priori* probable—that for uncounted generations the trend of migration was from the direction of Ireland through the islands of the west coast to the north of Scotland. We may reasonably assume that an exhaustive examination of the chambered cairns, in continuance of the work carried out with such marked success by Prof. Bryce, would give a similar result for the Neolithic Period.

Once the set of the current has been determined, it is not difficult to understand why regions, where the sheep and the deer now wander at will, should have been thickly populated in prehistoric times. Although the causes that prompted the movements of peoples in those far-off days are obscure, one of the most potent was certainly the demand that would be created for fresh means of subsistence when the mouths to be fed were multiplied. At intervals a surplus of humanity would be spilled from Ireland. In front there stretched but one open road, and that was a *cul de sac*. For, to those who followed this route, northern Scotland was literally the end of the world.

Long afterwards, under the pressure of a similar urge, a similar stream descended from Scandinavia. But the later immigrants came in stout ships, and could at need deflect their course, as they did, to the Faroes, to Iceland, even to Greenland. With the earlier wanderers it was different. When they had reached Unst, they would scan the horizon in vain for any sign of land to tempt their frail craft further. The ocean was an insurmountable barrier. The flow from the south would be brought to a standstill on its shore, and the more nearly that limit was approached, the greater would the congestion of population tend to become. This, I think, is the real secret of the abundance of Scotland's prehistoric remains.

Active Nitrogen.

By C. N. HINSHELWOOD.

IN 1900, E. P. Lewis observed that nitrogen could be stimulated by an electric discharge to emit a bright yellow glow, which continued for some time after the discharge had ceased; he made a number of spectroscopic observations on the glowing nitrogen. The present Lord Rayleigh investigated the phenomenon in a more general and systematic manner, discovered that the glowing gas had remarkable chemical properties, and named it 'active nitrogen.'

Certain important conditions must be observed for its production. The pressure of nitrogen should be a few millimetres of mercury: at higher pressures collisions with ordinary nitrogen molecules apparently destroy the glowing substance. The best procedure is to draw a stream of rarefied nitrogen through the discharge tube by means of a pump. The persistence and gradual decay of the glow in the gas which has left the region of the discharge can then be easily observed. When the discharge is from an induction coil, it should be a 'condensed' discharge, the use of the condenser giving a sudden intense current. The importance of this condition can be seen from the fact that if an uncondensed discharge is passed through the gas rendered luminous by passage through a condensed discharge, the glow is actually destroyed. Finally, the presence of a small proportion of some other gas in the nitrogen is necessary for the production of the luminescence.

At first it was thought that a little oxygen must be present, but methane, hydrogen sulphide, ethylene, and various other substances are equally efficacious. It seems to be generally agreed that a trace of some 'electronegative' gas, that is, a gas which readily takes up electrons to give negative ions, is the essential thing. A few parts per thousand of the foreign gas produce the most intense glow: larger amounts destroy it. In the presence of more than about 2 per cent oxygen, the nitrogen does not glow at all. Rayleigh thought that pure nitrogen still could be made to emit a faint glow, but Bonhoeffer and Kaminsky have shown that it emits none at all.

The glowing nitrogen was shown by Rayleigh to have great chemical reactivity, and also to excite many substances to luminescence. It reacts with acetylene to give hydrogen cyanide, and with mercury to give a nitride. Mixed with iodine vapour, it produces a brilliant blue light. Hydrogen

and the inert gases merely dilute the glow, but oxygen extinguishes it altogether. The reaction with nitric oxide is important: the gases interact with the production of a greenish flame, the evolution of heat, and the formation of nitrogen peroxide and nitrogen. Rayleigh and, later, Willey and Rideal have used this reaction as a means of estimating the concentration of the active body in a gas stream.

The nature of active nitrogen and the mechanism of its formation and decay have been the subjects of much research and speculation. The problem is not yet completely solved, but the range of possibilities has been very much narrowed down.

In the first place, although the production of the glow is determined by the presence of other gases, the actual emission process is one, apparently, in which nitrogen alone is concerned, for the spectrum is identical whether the impurity is oxygen, methane, or hydrogen sulphide. Moreover, the most important group of bands, the 'α-group,' which are three conspicuous bands in the red, yellow, and green, are simply part of the well-known 'first positive' bands in the ordinary nitrogen spectrum. (The intensity relationships are, however, quite different, a few of the bands being specially prominent in the glow and the rest entirely absent.) The 'β'- and 'γ'-groups of Fowler and Rayleigh have by many been attributed to nitric oxide, but these are not so characteristic, and are of less importance.

The glow is not associated with any ionic form of nitrogen: it is unaffected by the removal of ions from the gas which has passed through the discharge. Moreover, the spectroscopic evidence goes to show that the first positive bands of nitrogen are emitted by the neutral molecule itself.

In order to be clear about the value of the spectroscopic evidence, we must consider for a moment the nature of band spectra. In a given spectrum there may be several systems of bands in regions quite far removed from one another; each system has a number of more or less evenly spaced bands, the frequency differences between the centre of one band and the next being much smaller than those between corresponding bands of different systems. Finally, each band is composed of a number of lines which crowd together at one side or the other, producing a fluted appearance, the frequency differences here being on a still smaller scale. Now, according to the Bohr principle of energy levels, the frequency of the light emitted by an atom or molecule is equal to the difference between the energies of the initial state and the final state, divided by Planck's constant h. The energy of an atom, for this purpose, is determined by the quantum state of its electrons; changes in this correspond to the different lines in the *line* spectrum of the atom. The same applies to a molecule, but for each electronic energy level there are various degrees of vibrational energy possible; hence each line is multiplied into a system of lines. For each electronic and vibrational state various amounts of rotational energy may be possessed by the molecule; hence the system of lines becomes a system of bands.

The quantitative differences between the different kinds of energy fit in exactly with what is required to account for the relative frequency differences of system, band and component lines, so that there can be very little doubt that the nature of the spectrum proves the glowing of active nitrogen to be due to a molecule. It may also be mentioned that a line spectrum due to the nitrogen atom is known, but is not shown by active nitrogen; that Wien, by his canal-ray method, showed the emitting system of the nitrogen first positive bands to be uncharged, and that Rayleigh was unable to condense out anything which might indicate the existence of a body such as N_3. It seems fairly certain, therefore, that the characteristic luminescence is emitted by simple diatomic nitrogen in some unusual state.

The spectroscopic investigation carries us still a little further. From the frequency of the lines and from the Bohr principle, combined with measurements of the energy of the electrons necessary to stimulate the emission of various bands in the spectrum, an idea can be obtained of the actual energy levels from which any given line or band is emitted. In this way Birge, Sponer, and others arrive at the conclusion that the strongest bands in the afterglow correspond to transitions from a state where the nitrogen molecule possesses 9·3 volts of electronic energy,[1] with about 11 quanta of vibrational energy, which are equivalent to 2·1 volts. After these particular bands are emitted, the molecule still appears to have about 8·0 volts. Before emission it possesses 11·4 volts, or about 260,000 calories, which must be approaching the heat of dissociation of nitrogen. Saha and Sur conclude that the energy corresponding to the maximum frequency of the lines emitted when active nitrogen reacts with metals is 8·2 – 8·5 volts: but this is inconclusive, since chemical reactions are involved here, and it is well known that chemical energy may appear as light (chemiluminescence).

Willey and Rideal made a direct measurement of the heat liberated when active nitrogen reacts with nitric oxide, and found that 42,500 calories were contributed by the nitrogen for each molecule of nitric oxide which reacted. They assumed that each molecule of nitrogen accounted for one molecule of nitric oxide. This gave 42,500 calories (2 volts approximately) as the energy of the active nitrogen, in conflict with the spectroscopic evidence. The doubtful part of this procedure is simply the assumption of equimolecular equivalence: Rayleigh, for example, had assumed the reaction $2NO + N = NO_2 + N_2$, which would involve four molecules of nitric oxide to one of nitrogen. But this question may be left, since the conflict is resolved in another way. It has often been pointed out that active nitrogen may be complex, and contain different products in different states of excitation. Willey

[1] An energy of 1 volt means an energy equal to the kinetic energy which an electron would acquire in falling under a potential difference of one volt. 1 volt corresponds to about 23,000 calories per gram molecule.

has recently confirmed the fact that the glow and the chemical activity are independent: the glow may be destroyed, by Rayleigh's method of passing the gas through a weak subsequent discharge, without destroying the chemical activity. Hence it is clear that the average energy of nitrogen which is chemically active may be much smaller than that of the light-emitting molecules. Indeed, the balance of evidence seems to be that the chemical activity of the nitrogen is much smaller than it would be if all the molecules which are 'active' at all possessed energy equivalent to the spectroscopic 11·4 volts. For example, it does not excite molecules of hydrogen in any way, nor does it stimulate the combination of hydrogen and oxygen. Energy exchanges tend to be so specific that these arguments must not be pushed too far; but the evidence at present available seems to show that the glowing nitrogen is only a fraction of the total chemically active nitrogen, and in a considerably more excited state than the average.

We now come to the question of the mechanism by which these active molecules are produced and decay. In this connexion it must be remembered that most of the quantitative work on the subject refers to the glowing nitrogen, and not to other forms which are produced simultaneously, or in the course of the decay, which may still possess chemical activity although they are non-luminous.

It has been suggested that, in the discharge, free atoms of nitrogen are produced, in a manner analogous to that in which Wood's atomic hydrogen is formed. These have to give rise to a molecular spectrum, which they can do in two ways, either by simple recombination, or by communication of the energy of recombination to a normal nitrogen molecule which collides with two atoms at the moment of their union. It must be remembered, however, that the analogy between active nitrogen and active hydrogen is a very imperfect one. There is a marked correlation between the occurrence of active hydrogen and the appearance of the Balmer series, which is known to be emitted by the hydrogen atom, whereas the active nitrogen spectrum, as we have seen, is definitely molecular.

We thus have three possible views: (*a*) molecules of nitrogen excited in the discharge to a high energy level are 'metastable,' that is, they have a considerable life and can continue to exist for some time after leaving the discharge, when they slowly revert with emission of light; (*b*) atomic nitrogen emerges from the discharge, and then recombination takes place to give the molecules which are at a high enough energy level to emit the spectrum; (*c*) nitrogen atoms emerge from the discharge and cause excitation of normal molecules in a ternary collision ($2N + N_2$).

Of (*a*), all that can be said is that ordinarily an excited molecule loses its energy after about 10^{-7} seconds, but that 'metastable' states occasionally have to be assumed in spectroscopy. With nitrogen it would be an assumption made directly for the purpose of explaining the facts, and without independent evidence. The arguments against (*a*) are, however, principally the arguments for (*b*) or (*c*).

The rate of decay of the glow, for a constant total pressure, shows that the process is a bimolecular one (Rayleigh, Angerer, Bonhoeffer and Kaminsky, Willey). The simplest, though not the only possible, interpretation of this is that recombination of two nitrogen atoms takes place. This interpretation is also consistent with the fact that the estimated energy of the initial state from which the α-bands are emitted approaches the heat of dissociation of the nitrogen molecule. If we now assume (*b*) to be the mechanism, a spectroscopic difficulty arises, in that we should expect a certain amount of continuous spectrum from the recombination of free atoms. This difficulty possibly may not be a very serious one. However that may be, there is some theoretical reason for believing that free atoms cannot combine, unless they suffer a collision with a third molecule which can remove the excess energy liberated in their union. Otherwise, according to Herzfeld, they would fall apart again immediately. Thus (*c*) becomes a natural hypothesis to make, the third body being a nitrogen molecule which is excited to luminescence in the process.

Rayleigh found that the active nitrogen decayed more rapidly at low temperatures than at high temperatures. If the decay depends upon a ternary collision, this is natural, since the chance of such encounters decreases with increasing speed of the molecules.

If this hypothesis is true, the rate of decay should be directly proportional to the total pressure of the ordinary nitrogen. Opinion on this point is somewhat divided. It seems to be clearly shown that the glow decays more rapidly when the pressure of nitrogen is increased (Rudy, Bonhoeffer and Kaminsky, Willey), but Bonhoeffer and Kaminsky find that if more nitrogen is added to the glowing gas, it weakens instead of brightening the glow as might be expected. They consider this to disprove the suggestion that the decay is accelerated. The fact remains, however, that the weakened glow persists for a shorter time. Further investigation therefore seems to be needed.

It remains now to consider the part played by the small proportion of foreign electronegative gases in the production of active nitrogen. It must suffice to mention the possible explanations, without, at the moment, attempting to decide between them. We have seen that the impurities play no part in the actual light emission process. Their function must therefore be in some way to catalyse the formation of the atoms on the excited molecules in the discharge,—which is very unlikely,—or to retard the spontaneous reversion of the active nitrogen, which in their absence may be very rapid indeed, or take place by some process not attended with luminescence. Birge, from the point of view of the theory that the glow is emitted by metastable nitrogen molecules, suggested that these could only remain in their metastable state in the absence of a disturbing field, and that free electrons from the discharge would therefore cause a rapid reversion: a small amount of electronegative gas would 'clean up' these free electrons, while too

much would begin to exert a disturbing effect itself.

The alternative explanation is based upon analogy with atomic hydrogen, which can be definitely proved to recombine catalytically with great rapidity on clean glass walls of containing tubes: impurities such as water are shown to poison the walls and stabilise the atomic hydrogen. The impurities could have an exactly similar effect in preventing the destruction of the atomic nitrogen in a 'useless' wall reaction. In this connexion it is significant that Rayleigh found the decay to be much influenced by the walls of the vessel, while Bonhoeffer and Kaminsky showed that the effect of the different foreign gases was particularly a function of the walls.

The British Association at Glasgow.

THE 1928 meeting of the British Association will linger in the memory as a delightful reunion, at which, without the announcement of any sensational discovery, much useful and important work was accomplished. Centred in the midst of one of our greatest industrial and commercial communities, it has accomplished valuable propaganda work for science, driving home into the mind of the ordinary citizen some appreciation of the fact that not merely his material prosperity and comfort, but also a large proportion of all that renders civilised existence possible, is dependent upon science and its advancement.

The formal proceedings commenced upon the evening of Sept. 5, when Sir William Bragg took over the presidential chair in succession to Sir Arthur Keith. Between seven and eight o'clock the St. Andrew's Hall began to fill with an immense audience, who whiled away the time listening to an excellent organ recital and watching the platform fill with well-known figures of the worlds of science and citizenship. At 8.30 precisely, Sir Arthur Keith appeared, followed by the president-elect, the Lord Provost, and the Principal of the University. The proceedings opened with short speeches from the two last-mentioned, who with kindly warmth and facile wit bade the Association welcome to Glasgow. Incidentally, it may be mentioned that an outstanding feature of the Glasgow arrangements was the cordial and smoothly working co-operation of all concerned in making the meeting a success. In his presidential address, so admirably conceived to fit a great centre of art and craftsmanship and applied science, Sir William Bragg held his vast audience throughout with that success to which auditors of his lectures at the Royal Institution and elsewhere are accustomed.

On Thursday, Sept. 6, the various sections settled down to work, and those members of the Association more particularly who flit from section to section, whither for the moment their fancy leads, appreciated to the full the advantage of having the various sections housed, each in its own appropriate department, within the one ring fence of the University.

The sectional proceedings themselves have proved of great and varied interest and have aroused much appreciative comment. Here and there, glints of the sunshine of humour have illuminated the sombreness of scientific exposition and debate, as for example the comment that was heard after a paper by one of our brilliant marine zoologists upon a method which he had devised for collecting and recording upon a continuous band of silk gauze the minute forms of life constituting the plankton along the track of his ship. "What a wonderful young man!" the commentator said, "just fancy catching *whales* in a machine like that!"

As usual, during the week the centre of organisation has been the Reception Room in the Bute Hall of the University, the normally somewhat austere and cheerless interior of which, brightened up by the presidential banners hung round the gallery, has been from morning to night a scene of cheerful activity and bustle.

On Saturday, Sept. 8, the members for the most part forsook town for country—many accompanying one or other of the numerous excursions which had been arranged beforehand, others going off by motor-car on unofficial expeditions of their own. The good fortune of the Glasgow meeting did not fail it, for the gloom and rain of preceding days cleared away entirely and a pleasant south-westerly breeze with blue sky and heavy clouds gave to the full these light and shade effects which show western Scottish scenery to its greatest advantage. On Sunday again the same conditions held, and there were many who sought their sermons not in cathedral or church, but in the stones and running brooks of the Highland glens.

As was to be expected, social activities were a conspicuous feature of the Glasgow meeting: in fact, its activities may be said to have been inaugurated by a luncheon given on the opening day by the Glasgow Chamber of Commerce—the oldest of such chambers—to a number of the chief officials of the Association, while almost at its close came the annual dinner of the Clyde Navigation Trust, to which again were invited representative members of the Association's organisation. Both the usual evening parties were well attended. The first of these, on the evening of Thursday, Sept. 6, was given by the Lord Provost and Corporation in the magnificent City Chambers, and the invited guests had a delightful time—conversing with their friends, listening to an admirable programme of music, dancing, or looking on—and listening—during the—to many—unfamiliar evolutions of the Scotch reels. The second party, still larger though less crowded, was held in the spacious galleries of Kelvingrove, where the artistic and other treasures provided an endless source of interest.

On Monday, Sept. 10, a special honorary graduation ceremonial was held, in the presence of a somewhat restricted company owing to the Bute

Hall, in which graduation ceremonials normally take place, being in use as the Reception Room. The short list of graduands was restricted to the president and president-elect of the Association and foreign representatives, and consisted of Sir William Bragg, Sir Thomas Holland, Dr. Adrien Loir, representing the Association française pour l'Avancement des Sciences, Dr. F. L. Stevens, representing the American Association for the Advancement of Science, Prof. E. Suess, Prof. P. Zeeman, Prof. Shailer Mathews, and Prof. E. A. Westermarck. By a particularly happy arrangement the Frazer Lecture founded in honour of Glasgow's greatest living representative in the world of scholarship, Sir James G. Frazer, author of "The Golden Bough"—had been made to coincide with the first evening discourse, and Prof. Westermarck in his dual capacity delivered on Friday evening a fascinating discourse upon "The Study of Popular Sayings"—remarkable alike for its subject matter, its admirable English, and the thread of humour which ran through it.

As usual at British Association meetings, a centre of particular activity was the Conference of Delegates. Perhaps the chief item of business there decided was the unanimous adoption of a resolution proposed by Dr. Charles R. Gibson urging upon the Government "to stimulate the employment by local authorities of the powers already conferred upon them by Parliament for the preservation of scenic amenity in town and country." This resolution followed a powerful address by Dr. Vaughan Cornish, and was strongly supported by other speakers, including Lord Crawford and Sir John Stirling-Maxwell. An interesting announcement was made by Dr. Hamshaw Thomas that a conference summoned by Government had approved of a by-law prohibiting the public from uprooting ferns or other plants in places to which they had access.

It is not possible here to do more than merely mention one or two of the more important items of administrative business passed by the General Committee of the Association. Chief amongst these is the appointment of Sir Josiah Stamp as general treasurer in succession to Dr. E. H. Griffiths, whose retirement—forced by ill-health—was referred to in feeling and grateful terms by the president.

An invitation to meet in Bristol in 1930 was gratefully accepted, as well as a similar invitation from Leicester, the precise year being in this case left undetermined in the meantime. An invitation from Aberdeen was cordially appreciated, and a meeting there also foreshadowed in the near future.

Dr. Adrien Loir attended the Glasgow meeting and, announcing that the French Association would meet at Havre next year, extended a cordial invitation to such members of the British Association as do not go to South Africa to attend the meeting of the French Association. This invitation was, on their behalf, gratefully accepted by the General Committee.

The number of members registered was more than three thousand, as compared with 1912 at the last Glasgow meeting.

Obituary.

VISCOUNT HALDANE OF CLOAN, K.T., O.M., F.R.S.

THE death of Lord Haldane on Aug. 19 has removed from our midst not only a distinguished lawyer and statesman, but also a man of wide learning and a thinker of much ability and acuteness. I have been asked to give some account in these pages of his philosophical and scientific work, and of his labours in the cause of education. It is not a task easy to accomplish within the compass of a short article.

Richard Burton Haldane was born in 1856. His father, Robert Haldane, belonged to an old Scottish family, and was a Writer to the Signet in Edinburgh. His mother, who died in 1925, at the advanced age of over a hundred years, was a daughter of Richard Burdon-Sanderson, a Northumberland landowner. He went in 1873 to the University of Edinburgh and studied under Campbell Fraser. In due course he graduated with first class honours in philosophy, obtaining the Bruce of Grangehill Medal in metaphysics, and three years later the Ferguson Scholarship of the four Scottish Universities. Part of his student life was spent in Göttingen, where he worked under Lotze, for whom he always expressed profound admiration. In conjunction with his friend, Mr. J. Kemp, he translated Schopenhauer's chief work into English, the first of the three volumes appearing in 1883. He was Gifford Lecturer in St. Andrews in 1902–4, and his lectures, entitled "The Pathway to Reality," were published in two volumes in 1903 and 1904. His next considerable work, "The Reign of Relativity," did not see the light until 1921, although he tells us it was projected on the day of his release from office as Lord Chancellor in 1915. There followed in 1922 "The Philosophy of Humanism," and, in 1926, "Human Experience: A Study of its Structure." Haldane was raised to the peerage in 1911; and received the Order of Merit in 1915. He was elected fellow of the Royal Society in 1906; and, in 1914, fellow of the British Academy. In 1907–8 he was president of the Aristotelian Society, and he contributed many papers both to its *Proceedings* and also to *Mind*.

Lord Haldane's first published article, written in collaboration with his brother, Dr. J. S. Haldane, on "The Relation of Philosophy to Science," appeared in 1883 in the volume of "Essays in Philosophical Criticism," dedicated to the memory of T. H. Green,—a volume which also contains contributions from several other men who afterwards became well known, such as Andrew Seth, Bosanquet, Sorley, Henry Jones, and W. P. Ker. In this essay the Hegelian position, to which throughout his life Haldane steadily adhered, is concisely and lucidly set forth. The term 'mind' has, he insisted, a twofold significance. It may

mean the ultimate reality to which all existence is referable; and then it indicates not a substance or individual object of experience, but the creative synthesis of thought which, precisely because it is that which constitutes experience, cannot as such be made an object of experience. Or it may mean the individual conscious life, mind conceived as it appears, as its own object—having transformed its nature and become a definite part of experience—the subject matter, namely, of psychology. Thus mind may be regarded as at the same time creator and created, as at once infinite and yet a finite self.

Assuming, then, that the ultimate ground, the essence of reality, is mind or thought or self-consciousness, Haldane tried to show that notions such as those of causation and substance are but abstract categories, limited ways of thinking of things in knowledge, and that they do not indicate independent ways of existence in Nature. When the attempt is made to explain by their means the phenomena of life and psychical being they become, he argued, wholly inadequate. The properties of a body *qua* organised can no more be expressed in terms of these mechanical categories than the properties of a stone can be expressed in terms of moral judgment. He insisted that, if science is to do more than merely observe and record facts, it must recognise the necessity of a department of inquiry that shall deal critically with the categories it employs, assign to them their true position, and make clear the real nature of scientific method.

In the Gifford Lectures the line of reflection that had been thus adumbrated was elaborated in detail. In these lectures Haldane espoused Hegelianism with all the fervour of a prophet; he presented it as almost an inspired revelation which, when its meaning was grasped, would be seen to dispose of the enigmas that have long perplexed human reason. Once recognise the implications of the principle that the objective world, and the system of universals which it exemplifies, are but the workings of a mind which is not another than ours, but the mind in which all reality, our minds included, has its place, and one by one the problems of philosophy would be found capable of solution.

It seemed to many of us then, as it seems still, that Haldane took the 'pathway to reality,' even though entered upon under Hegelian auspices, to be a much shorter cut to that destination than we are entitled to suppose it is; but no one could doubt the sincerity of his assurance, or help admiring the pertinacity with which he sought to explain and defend the leading ideas of his idealistic system. Probably the most permanently valuable and original part of the work is that which is concerned with the method of scientific investigation and the relation to it of a criticism of categories. He submitted to scrutiny some of the main concepts of mathematics, physics, chemistry, biology, and psychology, for the purpose of showing that the categories of physics are less abstract and consequently nearer reality and truth than those of mere number, those of chemistry than those of physics, those again of life than those of chemistry, and those of mind than those of life. Particularly suggestive was his exposure of the notion of a special 'vital force' as the re-introduction, under another name, of the old mechanical theory; and, again, of the delusion of imagining that, because no specific 'vital force' can be detected, life must be simply a complicated mechanism.

After the publication of the Gifford Lectures, Haldane appears to have devoted a great deal of attention to the philosophy of mathematics, and especially to the mathematical conception of infinity. In his presidential address to the Aristotelian Society in 1907, he endeavoured to show that recent developments in logical theory, particularly those relating to the meaning of the notion of quantity, had a close bearing on the principles of the calculus. He pointed out, truly enough, the confusion into which Leibniz and some of Leibniz's contemporaries had fallen in speaking of infinitesimals as minute discrete quanta, the magnitude of which might be disregarded, just as the magnitude of a grain of sand might be disregarded when compared with the size of the ocean. A procedure of that sort would rob the calculus of any claim to exactness. The source of the confusion lay, he contended, in neglecting the consideration that quantity has two aspects, each implying and inseparable from the other, continuity and discreteness. If quantity be thought of in the latter aspect alone, the only 'infinite' conceivable will be, he argued, the 'false' infinite of mere unendingness in increase or decrease of finite quanta. On the other hand, the infinity which belongs to the continuous aspect of quantity cannot be reached by addition or subtraction; and, this being realised, the so-called infinitesimal calculus may be consistently treated as a science not of infinitesimals, but of 'rates,' its peculiar province being quantity regarded as a state of continuous change. Thus we may arrive at the notion of infinity in the sense of what is self-contained. But still the relations so treated would be abstract; what is abstract has been wrenched from a context, and has, therefore, something outside itself. The 'true' infinite must be both concrete and completely self-contained; and only the Absolute can be that.

It must, I think, be admitted that, although his criticisms of Leibniz were perfectly justifiable, Haldane was, in this context, flogging a dead horse. In working out a theory of the calculus, the modern mathematician no longer assumes either infinitely small quantities or infinitely small numbers. He proceeds from the fundamental concept of a *limit*,—a purely ordinal notion, which involves no reference to quantity at all, and no such entities as 'infinitesimals' or 'negligible differences.' The modern mathematical conception of the infinite may not be free from logical difficulties, but it would seem to be as remote from what Hegel called the 'false' infinite as it is from what he called the 'true' one.

It is worth noting that in the early essay, to which I have alluded, of 1883, Haldane had already laid stress upon the consideration that space and time are not separable from, or independent of, one another, that they exist only in co-ordination as contributing to the constitution of a highly

concrete reality which they do not exhaust. He was thus to some extent anticipating the merging of space and time into space-time, which is probably the most radical innovation introduced by the theory of relativity, and that aspect of it which is of chief philosophical importance. Of course, in the large volume published in 1921, Lord Haldane reasserted the same contention, here, however, as an outcome of the scientific investigation of the twentieth century. But he went now much further, and maintained that the theory of relativity is, in truth, simply an illustration of the application of what he called the philosophical principle of relativity to a special domain. By the term 'relativity' in the philosophical sense he understood the doctrine that Nature is unintelligible apart from its relation to knowledge, and indeed that individual knowledge is unintelligible apart from a structure which is 'foundational' in the knowledge of every individual knower. Einstein, he insisted, was concerned with a series of meanings which possess veracity only relatively to knowledge.

Notwithstanding the ingenuity with which this thesis was enforced, it has failed, I think it must be confessed, to produce conviction. So far as I can see, the physics of Einstein takes no more account of the relativity of Nature to knowledge than did the physics of Newton. It is true that in popular expositions of the theory reference is frequently made to the 'observer.' Yet that surely is merely an expository device for indicating that the relations observed are in each case dependent upon the space-time framework to which the *body* of the observer belongs. The 'observer' might be replaced by a photographic plate, and the facts with which the scientific theory of relativity is concerned would remain unaffected.

The interest of the book lay, however, not in its handling of the scientific theory of relativity, but in its comprehensive presentation of that form of idealism upon the elaboration of which Lord Haldane had spent so many years of patient thinking and reflection. This was far from being a mere re-statement of what he had said before; it was the result of a careful working over again of the old material, in the light of maturer insight and wider experience. He had not been uninfluenced by the movements of speculation since the days of his Gifford Lectures. It now seemed to him advisable to name the essence or *prius* of reality not as thought or experience, but as knowledge,—knowledge in the fullest sense, including within it both feeling and conation. By 'knowledge' he evidently meant that which must in some way be conceived as a synthesis of both knowing and the known. Human experience was undoubtedly a type of knowledge; but it implied, as the ground of its possibility, knowledge that is final and ultimate. The world confronting us is, indeed, actual, and independent of us, its observers. Yet that is not the last word about either it or ourselves. Both belong to a greater entirety; and only in so far as they fall within the sphere of knowledge have they either being or meaning.

I have but little space left in which to refer to Lord Haldane's activities as an educationist. No politician of his time was more alive than he to the necessity of a thoroughly efficient educational system for a democratic State. He saw clearly that no system of elementary education ever can be efficient unless it form part of one comprehensive scheme in which the universities are given the lead. Frequently he laid before large assemblies, sometimes of students and sometimes of business men and manual workers, his conception of the ideal of intellectual culture, and of what the effort to realise it would mean for the welfare of the whole community. He was an ardent supporter of the Workers' Educational Organisation and of the Institute of Adult Education. The younger civic universities found in him a staunch friend; and, in the address which he gave on being installed as Chancellor of the University of Bristol in 1912, he spoke with enthusiasm of their manifold opportunities. But he was not less attached to the university system of his native Scotland. He was Chancellor of St. Andrews as well as of Bristol. "The corporate spirit of University life," he told the students of Edinburgh as their Rector in 1907, "needs but little surrounding for its development, and that little it finds as readily in the solitude of the Braid Hills as on the banks of the Isis or the Cam, in the walks round Arthur's Seat as in the gardens of Magdalen or Trinity." Nor ought one to omit to mention the signal services he rendered as chairman of the Royal Commission on University Education in London, appointed in 1909. The Report of that Commission, a remarkably lucid and exhaustive document, was issued in 1913; and put forward recommendations of far-reaching import, the adoption of which would have meant the establishment of an adequate and worthy university for the metropolis. If it be permissible to note small things along with great, I should also like to place on record that one of the last acts of Lord Haldane was to preside, in July last, over a gathering of friends met to do honour to Prof. John Dewey, of Columbia, the distinguished American educationist, on the occasion of a brief visit of his to Great Britain.

English public life can ill afford to lose a man of the uniqueness of Lord Haldane. If he had devoted himself wholly to philosophy, he would probably have left behind him scientific work of greater originality. But if he had devoted himself wholly to politics, it is certain that he would have influenced the world far less than he did and would not have been the striking personality he was.

G. DAWES HICKS.

IN Viscount Haldane the Empire has lost one of its foremost citizens, a man to whose abilities and devotion it owes an incalculable debt. The work for which history will chiefly remember him was done in fields that seem to occupy opposite poles of practical activity—war and law. Yet the greatness of his achievements in regions so diverse is not to be taken merely as a proof of versatility—which is often shallow as well as brilliant—or of restless energies ever seeking new

worlds to conquer. It was due rather to qualities central and typical in him: namely, his power to see the vital needs of the community steadily and as a whole, his profound conviction that those needs can be met only by unremitting intellectual labour, and his extraordinary capacity for getting broad ideas translated into administrative detail. The immense value of his services at the War Office during the critically important period from 1906 to 1912 is now universally recognised, and is his most obvious claim upon the gratitude of posterity. But his work, since 1918, as a member of the Judicial Committee of the Privy Council may prove, in the end, to have scarcely less importance. For the War, which left nothing unchanged, has transformed the British Empire we know into a Commonwealth of Sovereign Nations, and so created problems, legal and constitutional, of the utmost gravity and delicacy. It is characteristic of Lord Haldane's profound practical intelligence that he appreciated at once the emergence and significance of the new order, and of his patriotism that, ignoring medical warnings, he spent the whole reserve of his physical strength in seeking to guide upon sound lines the most amazing and possibly the most hopeful political experiment the world has seen.

When we consider what the country owes to this great public servant and how inadequately the debt was acknowledged, one is tempted to think that it scarcely deserved him. It is true that the ignorant and almost insane detraction which drove him out of the Cabinet early in the War is now silent, and that during the last years of his life he enjoyed increasingly general respect. Yet the respect was undoubtedly cool—even, one must admit, a little grudging. This is explicable in part by his lack of certain personal and temperamental gifts that make an easy popular appeal; but the fundamental cause lies in a defect of the public mind which has again and again been deplored in the pages of NATURE. We do not mind a minister's having a little learning, provided that he wears it solely as a flourish upon his more solid qualities; but we are incurably suspicious of one who attempts to bring theoretical ideas to bear upon important public business.

Now Lord Haldane was guilty of this fault in its worst form. It would not have mattered that, bred a student of philosophy, he remained one to the end. The serious thing was that his philosophy was the mainspring of his life, and that he sought deliberately to bring his immense practical capacity under its control. His mind was formed, at Edinburgh and Göttingen, under Hegelian influences, and these remained strong with him throughout life. (A month before his death he told the present writer that he had returned to the great works of Hegel and was pondering them nightly, sentence by sentence, in bed; and added, with pathetic humour, that he deemed himself to be the last Hegelian left in Britain.) The value of his contribution to the Hegelian tradition is considered in another article, but it is essential to note here that for him its central doctrine took the form of a conviction that reality is to be identified with knowledge; for that conviction gave unity and force to the whole of his life, and is the key to an understanding both of his achievements and of his limitations. From it was derived the profound appreciation of the value of science—rare both in a philosopher and in a minister of the Crown—which was expressed in his cultivation of personal relations with his great scientific contemporaries, in the eagerness with which he sought to grasp the significance of modern developments in biology and physics, and his ability to understand and utilise fully the services of expert advisers of the Government in matters of great national moment.

From it above all sprang his passionate belief in education. What Lord Haldane did in this field is not likely to be fully revealed, for so much was done behind the scenes and incidentally. But the cause of national education in all its grades had no more powerful friend; and the immense progress that has been made in recent years owes a great deal to his wide vision, to his warm and watchful sympathy, and to the power of his persuasive advocacy exerted in quiet corners and at critical moments. University education, both in England and in Ireland, is particularly indebted to him; and it was, perhaps, fortunate that the great friend of the new universities was one who had not been hypnotised by the traditions of Oxford and Cambridge. From Haldane's philosophical point of view, nothing was more essential to national wellbeing than a strong and comprehensive university system. The universities were, in his view, centres of consciousness where cultural and practical experience, in its chief modes, was to be worked up into that exact knowledge which would raise the level of reality of the nation's life. Thus is to be explained, for example, his enthusiastic co-operation in the founding of the London School of Economics and his general interest in enlightened professional education. From the same source sprang his invaluable faith in the destiny of such organs of general education as the Birkbeck College and the British Institute of Adult Education.

It was an unseemly jest of fortune that, in the public mind, Lord Haldane should be connected with the University of London mainly through his chairmanship of an unpopular Commission. The Report of that Commission was undoubtedly an extremely able document, full of interesting ideas courageously set forth, and inspired by a wide and lofty vision of the possibilities of the metropolitan University. The constitutional architecture it planned was, however, too formal, narrow, and precise, and it is unlikely that the untidy soul of the University could have inhabited it and grown in it happily. On the whole, it is lucky that events cut short a somewhat heated debate about its merits and demerits, and that the Departmental Committee, returning in 1925 to the insistent problem of the reorganisation of the University, could reconsider it in an atmosphere cleared by the storms of war. It would, however, be unjust not to recognise that the scheme of the Departmental

Committee embodied in the Statutes now awaiting confirmation, though it makes important concessions to historical features in the University which the Haldane Report treated rather shortly, yet draws from that Report most of its vital ideas. It must also be acknowledged that since 1913 feeling and opinion within the University have moved perceptibly and even strikingly towards a unity that makes those ideas more acceptable than they formerly were. It is too soon to prophesy about the University of London; but it may yet become a monument to the wisdom and imagination of those who saw in it possibilities of immense usefulness, and laboured to set it upon the path of realisation. Among these Viscount Haldane will certainly hold a very high place.

Lord Haldane was so accessible and so widely known that it would be impertinent for one who cannot claim exceptional intimacy to attempt a sketch of his personality. Such a one may, however, be permitted to record that in prolonged conversations in recent years, during which the great statesman, student, and man of affairs talked freely about many phases of his wonderful experience, he never uttered a word of bitterness, and that one caught glimpses of a faith, a courage, and a spiritual nobility that could not but evoke reverential esteem.

T. P. NUNN.

News and Views.

THE members of the Council of the British Association elected at the Glasgow meeting are as follows (the names of new members are in italics): Prof. J. H. Ashworth; *Dr. F. A. Bather*; Rt. Hon. Lord Bledisloe; Prof. A. L. Bowley; *Prof. C. Burt*; Prof. E. G. Coker; Prof. W. Dalby; Dr. H. H. Dale; *Prof. C. Lovatt Evans*; Sir J. S. Flett; Sir Henry Fowler; Sir Richard Gregory; *Dame Helen Gwynne-Vaughan*; Mr. C. T. Heycock; Mr. A. R. Hinks; Sir Henry Lyons; *Mr. C. G. T. Morison*; Dr. C. S. Myers; Prof. T. P. Nunn; Prof. A. O. Rankine; Mr. C. Tate Regan; Prof. A. C. Seward; Dr. F. C. Shrubsall; Dr. N. V. Sidgwick; Dr. G. C. Simpson. Prof. J. L. Myres and Dr. F. E. Smith have been re-elected general secretaries. During the past year the Council was again deprived of the presence of Dr. E. H. Griffiths, general treasurer, owing to ill-health, but it is gratefully recorded in the Council's report that he did not allow this to deprive the Council of his valuable advice and reports on the finances of the Association. Nevertheless, Dr. Griffiths again tendered his resignation, and the Council, with the deepest regret, felt that he should not again be pressed to withdraw it. In accordance with precedent, the Council consulted a committee consisting of the president, general officers, and ex-presidents, in considering the nomination to be made in the room of Dr. Griffiths, as a result of which Sir Josiah Stamp has now been appointed to the office of general treasurer of the Association.

AN afternoon meeting at Glasgow of Section D (Zoology) of the British Association was devoted to a discussion of the work of the *Discovery* expedition. Dr. S. C. Kemp opened with a general account of the expedition; readers of NATURE will remember that Dr. Kemp has contributed articles dealing with the expedition to our columns (Oct. 30, 1926, and May 19, 1928). Mr. E. R. Gunther then described the distribution of the plankton on the whaling-ground, and Prof. A. C. Hardy showed its curiously discontinuous character. Unevenness was first revealed by his ingenious 'continuous plankton recorder,' but systematic netting during long runs indicated that the particular plankton (*Euphausia*) which is the food of the whale exists in dense patches a hundred metres or so in diameter and a kilometre or so apart. Mr. N. A. Mackintosh gave many interesting facts resulting from the examination of the carcases of 1683 whales. The growth was traced from the earliest embryo $\frac{1}{16}$ in. in diameter, through the recognisable fœtal whale of 6 in. long to the new-born 'baby' of 21 feet; then through lactation to weaning, and through adolescence to the astonishingly early maturity. The papers were discussed by Prof. Garstang, Dr. Chalmers Mitchell, Prof. Peacock, Mr. Heron-Allen, Dr. Cunningham, Mr. Arthur Earland, Dr. Bidder, Mr. Elmhirst, and others.

THE president of Section D, Prof. W. Garstang, in thanking the director and zoologists of the *Discovery* expedition for their communications, said that members of the Section had now heard preliminary accounts of all the *Discovery* researches. They had judged thereon that the scientific investigation had been well planned and well executed, and the interim reports alone were very valuable. In the name of Section D he assured Dr. Kemp and his colleagues that zoologists admire these achievements and the work which has led to them, and have full confidence that the further progress of the expedition will be marked by the successive attainment of valuable and well-founded results.

OWING to the regulations governing the introduction of scientific films into Great Britain, the paper by Prof. Rathjens on his explorations in Arabia had to be withdrawn from the programme of the recent International Congress of Orientalists at Oxford. It will be remembered that the Chancellor of the Exchequer has conceded that scientific films may be brought into England free of duty on a certificate from the Royal Society to the customs authorities that the film illustrates a scientific investigation (see NATURE, July 28, p. 138). Notwithstanding the fact that Prof. Rathjens on Aug. 9, and the secretary of the Congress on Aug. 10, had made application to the Commissioners of Customs for the admission of the film, and application was addressed to the Royal Society for the desired certificate, the customs authorities were prepared to admit the film only on a deposit of the duty, £31, 10*s*., "to be refunded in the event of the film being certified by the Royal Society." The ground for this decision was that the Royal Society being in vacation, it was difficult "to

make contact with officers of the Society qualified to give decisions in these matters." In the circumstances there was no alternative but for the paper to be withdrawn. A concession which functions only when the certifying body is not in vacation and its officers are accessible evidently scarcely meets the needs of the case.

THE justification for international congresses is, as Sir Charles Close states ("International Geographical Congresses," R. G. S.; 1928), that science is essentially international, and every worker finds, from time to time, the need of freeing himself from the intellectual preoccupations of his fellow-countrymen. This is especially the case with geography, which of all branches of knowledge requires most to be studied from the point of view of a citizen of the world. The first International Geographical Congress was held at Antwerp in 1871; the twelfth, in Cambridge in July last. The history and proceedings of these congresses reveal in some measure the progress of an old study under the precision imposed by modern science and modern needs. The record of the many resolutions dealing with cartography gives a strong impression that the map is the essential foundation upon which geography is built. It is therefore significant and interesting to note that the International Map of the World owes its inception to a suggestion made by Dr. Penck at Berne in 1891. The congress at Geneva in 1908 unanimously accepted various principles for its construction and prepared the way for the International Conference on the Map of the World which met in London in 1909; followed, after the Rome Congress in 1913, by a further Conference in Paris, when the Map was definitely standardised.

THE various sections into which each geographical congress has divided its proceedings reveal the width no less than the depth of geographical study. Nevertheless, the great guiding principle has been repeatedly enunciated. Fr. Alexis defined it at Paris in 1875 thus: "L'objet de la géographie est double: en premier lieu, la connaissance de la configuration naturelle de la surface terrestre, considérée en elle-même (géographie physique); en second lieu, l'étude du rapport de la Terre avec ses habitants (géographie politique, ethnographique, économique, etc.)." Sir Charles Close, in concluding his survey of the congresses, states: "The general aim is clear; by travel, by exploration, by the apparatus of maps, by detailed investigations, by the study of historical records, to learn all we can about the Earth, considered especially in its aspect as the home of man."

THE problem of crime is of more than biological interest, but it has its biological side, and Dr. Charles B. Davenport discusses this in the *Journal of Heredity* (vol. 19, No. 7, 1928), under the title "Crime, Heredity, and Environment." From the biological point of view, the important element in criminal behaviour is the failure of the individual to meet the requirements of the mores, that is, the conventional rules of behaviour, which differ in different countries. Such failure is due neither wholly to lack of suitable training nor wholly to heredity, but nevertheless behaviour depends upon the constitution of the individual criminal, and training, in order to be effective, must not be of a general miscellaneous kind, but must take cognisance of the special make-up of the individual. Dr. Davenport's first step in combating crime would be the prompt and painful punishment of the criminal, for this is not only a physical deterrent, but also, from the obvious sequence of cause and effect, it strengthens the weak inhibitions characteristic of most criminals. As a second step our author would study the individual to find out the particular trait of his character that has made the particular criminal act possible, in order to see whether anything can be done to correct that condition.

WE are of opinion, however, that Dr. Davenport has overlooked the very first necessity in combating crime, and that is the certainty of detection: first catch your criminal. On one occasion we discussed the problem with one of the best known of Scottish judges, who has studied the problem in America as well as from the Scottish bench, and his reasoned conclusion was that the amount of serious crime increases in proportion with the probability of eluding detection and escaping the consequences. The extraordinary number of serious crimes in proportion to the population of the United States as compared with those in Great Britain has to be read, he held, in the light of the high percentage of detection and subsequent punishment in the latter, in contrast with the high percentage of total escape, or escape from adequate punishment, in the United States.

THE Forest Products Research Laboratory, instituted at Princes Risborough under the auspices of the Department of Scientific and Industrial Research, has already been alluded to in NATURE. The investigations now being carried on are an outcome of the wholesale felling of woods in Britain during the War, the threatened shortage of supplies, and the waste in utilisation. The primary purpose of the laboratory is therefore to promote the more economical use of timbers by the wood-using industries of the country. This object can be attained through a knowledge of the strength factors of various timbers and grades of timber, by better seasoning, and so forth. A small pamphlet has recently been issued from the Laboratory on "The Uses of Home-Grown Timbers." This brochure has been compiled by a Committee representative of the Land Agents' Society, the Federated Home-Grown Timber Merchants Association, the Royal Institute of British Architects, and the Forest Products Research Laboratory. The investigations of the committee are of interest since they revealed three facts: (1) that architects in Great Britain usually specified for foreign timber owing to the variety of choice and the certainty of supplies; (2) apart from building operations, there were a great many outlets for home-grown timbers: with a closer knowledge of their properties a larger demand might be expected; (3) that this demand will be increased by the more careful seasoning and grading of the home-grown product. It is recognised that more scientific forestry methods are necessary for the production of straight clean timber free from knots, and that better facilities

for marketing would be obtained by the concentration of woods in large compact blocks. The greater part of the pamphlet is devoted to a schedule dealing with the most important of the home-grown timbers. Each timber dealt with is briefly described, and the demands for it are classified under the following five heads: (*a*) When the British timber is more often used; (*b*) when the foreign timber is more often used; (*c*) when both are more or less equally used; (*d*) when the British timber is more suitable; (*e*) when the foreign timber is more suitable.

PERHAPS one of the most important items in the programme of work which is being undertaken by the Forest Products Research Laboratory is a comprehensive study of the mechanical and physical properties of home-grown and imported timber. It is proposed to publish the results of these investigations as data become available and the lines of work are based on those already established and in use in similar laboratories in India, Canada, and the United States. In a recently published pamphlet entitled "Project 1, Mechanical and Physical Properties of Timbers—Tests on Small Clear Specimens," a detailed account of the methods employed in such investigations is given, together with a definition of the principal technical terms. The compilers of the pamphlet correctly say that much of this will be known to fellow investigators, especially in connexion with the standardised tests on small clear specimens. The main principle, which is clearly indicated in the pamphlet, is that a common standardisation of tests and standardised specifications have been adopted by India, Canada, and the United States; and the laboratory at Princes Risborough in England has fallen into line with the similar laboratories in the other three countries.

THE eighth annual report of the Council of the Research Association of British Motor and Allied Manufacturers is now available, and contains notes on many valuable papers which have been circulated among its members. Fundamental work on problems relating to springs and ferrous metallurgy in general has been attempted, and large numbers of air filters, manifolds, silencers, brake fabrics, and other motor components have been examined with the view of effecting improvements in design or to increase resistance to wear. It is to be regretted that the activities of the Association are hampered by lack of support of the industry, which by a voluntary levy of 6*d*. per motor vehicle could produce annually a sum much in excess of the subscription income of £4200 which was necessary under the conditions recommended by the Department of Scientific and Industrial Research to make the Association eligible for a grant.

IN celebration of the tenth year of the existence of Czechoslovakia, an exhibition of contemporary culture and scientific achievement has been arranged at Brno, in Moravia, and will remain open until the end of October. The exhibition is designed to show the progress made during the country's brief existence. The scientific and general studies conducted in different types of schools, institutes, and colleges are portrayed, culminating in the research exhibits from the science faculties of the universities and from special research associations. The great increase in the number and circulation of cultural periodicals, the production of books, and the number of libraries opened, afford a striking testimony to the progress made. The undertakings of governmental ministries and transport developments are also intimately connected with this cultural progress, and whilst new railways have been laid, air services opened, postal, telegraphic, and telephonic communications improved and extended in remote areas, much still remains to be completed, and such work already in hand is depicted as though it stood, like an artist's unfinished picture, upon an easel.

The Brno exhibition is arranged to show the close interrelationship between the State, the sciences, and general culture. The spread of ideas through the receipt of foreign journals and news is expressed by a long aisle, the white walls of which have dark lines to represent railway tracks. The engineering difficulties encountered in duplicating lines in poorly served areas have brought together specialists in different branches of pure and applied science, and such connexions are cleverly indicated. Other links, such as that of the Ministry of Health with the radium exhibit from Jáchymov and the products from other curative spas, are emphasised. The recent growth of towns, urbanism, is depicted by statistical designs among small-scale apparatus illustrating the latest methods in purifying water supplies, generating electricity, etc. Sciences concerned with inanimate matter and those which are observational and descriptive occupy the ground floor; the mathematical sciences are above, whilst the philosophical studies are placed still higher. Architecturally the main hall is a surprise of impressive spaciousness. The graceful parabolas of concrete admit a maximum of light; smaller surrounding pavilions contain exhibits of the public works of important towns and the arts sections of culture.

THE reports of the council and director of the Norman Lockyer Observatory for the year ended Mar. 31, 1928, show that, in spite of exceptionally unfavourable weather, the useful work which this institution has been carrying on for several years past has been well maintained. With the exception of an expedition (ruined by clouds) to Richmond, Yorkshire, to observe the total eclipse of the sun in June 1927, there has been little variation in the former programme of work, the main features of which are the classification of stellar spectra from original observations, the determination of spectroscopic parallaxes, particularly of early-type stars, and the special study of certain bright-line hydrogen stars. Considerable repairs to the observatory buildings have been carried out, and the equipment has been increased by the addition of some good lenses, which have been purchased at a low figure. Unfortunately the financial position of the observatory is not so favourable as might be desired, the

accounts for the year showing a deficit of £55 2s. 9d. It has been necessary to reduce the scholarship grant from £150 to £100 per annum. The income is still largely dependent on special donations and subscriptions, and it is greatly to be hoped that increased help will shortly be forthcoming so that the very valuable work which the observatory performs may be carried on without the embarrassment of inadequate financial means.

MR. L. A. REDMAN, the author of "The Einstein Delusion and other Essays," in a communication to the editor, objects to two passages in the short notice of his book in NATURE of June 23 (vol. 121, p. 979), namely, (1) "scarcely any reference is made to the original publications of Einstein and his successors," and (2) "other topics, mainly mechanical." The second objection is due to a misunderstanding of the term 'mechanical,' which in the notice is used in the wider sense 'pertaining to mechanics' (cf. "Chambers's Dictionary"); 18 of the 24 "other topics" can be included under this head. As regards the first objection, the title chosen by Mr. Redman for his book clearly points to the first essay as by far the most important in his own estimation; in fact, most of the others deal with problems familiar to students of mechanics and call for no special mention. The first essay contains 43 references of all degrees of importance, including a score or more to popular books, 8 to Einstein's popular (gemeinverständlich) tract on "Relativity," 4 to Eddington's "Space, Time, and Gravitation," 5 to various experimental papers, and 4 to the writings of Prof. Poor. There is no reference whatever to the *original papers* of Einstein himself, nor of Poincaré, Minkowski, Weyl, Levi-Civitá, to mention only a few of his successors, and none to any authoritative treatise later than Eddington's "Space, Time, and Gravitation," not even to his "Mathematical Theory of Relativity."

THE International Federation of Intellectual Unions (Internationaler Verband für kulturelle Zusammenarbeit) announces a fifth congress to be held in Prague on Oct. 1–3. Lectures and discussions will centre round the theme "The Elements of Modern Civilisation." Among expected speakers are A. Fontaine of the Bureau International de Travail, Geneva, the architect le Corbusier, the psychoanalyst Jung, and the sociologist De Man. The first congress was at Paris under the presidency of Borel; since then the Federation has met in Milan, Vienna, Heidelberg, and Frankfurt. As now organised, the Federation is based on unions in Germany, Austria, Belgium, Spain, Esthonia, France, Hungary, Italy, Poland, Roumania, and Czecho-Slovakia. It is officially registered with the International Institute of Intellectual Co-operation in Paris. There is still no formally affiliated British union, but contact has been made with the Information Service on International Affairs, 10 St. James's Square, London, S.W.1, and Mr. Denis Buxton, of 43 Campden Hill Square, London, W.8, is one of the five members of the permanent committee. Applications for membership and for more detailed programmes should be made to the secretary of the Federation, Prince Charles de Rohan, Wien IV., 18 Rainergasse, Austria. The objects of the Federation include the fostering of personal relationships among the 'intelligenza' of Europe by opening correspondence with distinguished foreigners, by personal introductions, and by hospitality to strangers, especially those on professional errands. Any efforts to reconstruct European society may be welcomed. The history of international societies indicates that a definite aim and open adhesion have been conditions of lasting success.

LIEUT.-COLONEL J. T. C. MOORE-BRABAZON has accepted the invitation of the Council to become president of the Junior Institution of Engineers in succession to Sir Murdoch MacDonald. His induction will take place at a meeting to be held at the Royal Society of Arts on Friday, Dec. 7, when he will deliver his address.

WITH reference to the academic and other honours which distinguished the career of the late Viscount Haldane, it is noteworthy that he was elected to the fellowship of the Royal Society in November 1906, and thus whilst a commoner. Also, the date coincides with the election of the late Edward Cecil Guinness, Earl of Iveagh, both being specially selected for inclusion in the Society's ranks on the ground of services to the cause of science. It is of interest to recall that the above nominations were made during the presidency of Lord Rayleigh (1905–1908).

IN connexion with the forthcoming British Industries Fair (1929), we are informed that the space already taken in the Scientific Instrument Section is 6520 square feet, and 56 firms are participating. Thus the figures for the 1928 Fair, namely, 5990 square feet and 52 firms, have already been exceeded. The total space for the whole of the British Industries Fair at present allotted is 211,000 square feet, and 781 firms are taking part.

As in previous years, during the forthcoming winter, Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff, will be able to give a few lectures to Chambers of Agriculture and Horticulture, Farmers' Clubs, Farm Workers' Associations, Agricultural Societies, etc., on the Rothamsted experiments. No fee will be charged for the lecturers' services, but any association engaging them would be expected to defray their travelling and hotel expenses and to make such arrangements for the lectures as may be necessary. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

THE Palæontologische Gesellschaft is to meet this year in Budapest on Sept. 26–29, and the meeting will be followed by excursions lasting until Oct. 5. The complete cost is estimated at 12 shillings a day. Communications are promised by K. Beurlen, T. Edinger, K. Ehrenberg, K. Lambrecht, A. Liebus, R. Richter, and O. H. Schindewolf. Details can be

obtained from "Direktion der Kgl. Ung. Geologischen Anstalt, Budapest VII, Stefánia-út 14."

IT was reported recently in the daily press that the late Count Vigyazo had bequeathed his estate, valued at more than two million pounds, to the Academy of Sciences at Budapest. The secretary of the Academy, in reply to an inquiry, informs us that the value of the bequest has not as yet been fully assessed, and that it is uncertain when the Academy will be able to enter into possession in view of the fact that several legal actions are still undecided, and the Count's title to certain parts of his possessions is being contested. The revenue of the estate would be used by the Academy exclusively for scientific and national purposes.

THE entire issue of *Die Naturwissenschaften* for June 1 is devoted to a summary of the results of a dozen recent researches carried out in the Kaiser Wilhelm Institute—in experimental embryology, on the cerebral cortex, and on various physical and chemical problems—and to records of the principal activities of the Kaiser Wilhelm Gesellschaft from April 1927 to March 1928, including the reports of the various Institutes. The reports afford striking evidence of the scientific energy and enterprise of the Institutes.

VOLUME 20 of the Collected Researches of the National Physical Laboratory has 444 pages, and includes 30 memoirs published in the years 1920–1927 dealing with questions of an optical character. Of these memoirs, Mr. T. Smith, the head of the Optical Division, is responsible for 13, which deal with the properties and defects of the component parts of optical instruments. Mr. Guild is responsible for 8, mainly concerned with colour measurement, and Dr. Walsh for 4 dealing with problems of photometry. A short abstract precedes each memoir, so that the reader may quickly make himself acquainted with its object and results. Any reader who does so must be impressed with the great value to the various branches of the optical industry of the work which has been done at the Laboratory during the period covered by the volume.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant bacteriologist at the University of Durham College of Medicine, Newcastle-upon-Tyne—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne (Sept. 22). An agricultural economist at the North of Scotland College of Agriculture—The Secretary, North of Scotland College of Agriculture, 41½ Union Street, Aberdeen (Sept. 22). A part-time woman demonstrator in chemistry in the Household and Social Science Department of King's College for Women—The Secretary, King's College for Women, Campden Hill Road, W.8 (Sept. 25). An assistant conservator of forests under the Department of Agriculture and Forests of the Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (Oct. 6). Male assistant superintendent of traffic (Class II.) in the London Telephone Service, and male assistant traffic superintendent in the Provinces, G.P.O.—The Secretary, Civil Service Commission, Burlington Gardens, W.1 (Oct. 25). A head mastership of the King Edward the Sixth High School for Boys, Birmingham—The Secretary, King Edward's School, Birmingham. Evening lecturers in structural engineering and graphics, structural steelwork design, and reinforced concrete design, respectively, at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. An assistant wireless engineer for the Public Works Department of the Government of Hong-Kong—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/943).

Our Astronomical Column.

METEORS AND METEORITES.—The *Nineteenth Century* for September contains an interesting article by Mr. A. R. Hinks on meteors and meteorites, suggested, as he says, by Prof. Olivier's recent book on the subject. The book regards large and small meteors as members of the same class, but Mr. Hinks gives reasons for his dissent from this view. He recalls with approval Sir Robert Ball's suggestion that the larger meteors may have been expelled from terrestrial volcanoes in long past ages. Their orbits would continue to lie near that of the earth, so that an eventual return to it would not be improbable. He also regards as inconceivable the idea that meteors of the complicated 'plum-pudding' structure could have originated either in the sun or in interplanetary space; they must have been formed on some planetary body, and the earth is the most obvious suggestion. His argument might also be used to support Proctor's view that the comets of short period had been expelled from Jupiter and the other giant planets.

Mr. Hinks turns to the masses of iron which are classed as meteoric but were not seen to fall; he notes that five-sixths of them were found in America and Australia, whereas the recorded falls are in a majority in the old world. He explains this by supposing that most of these masses have never left the earth, but were, like the others, the products of volcanic activity. Their distribution may either indicate greater volcanic activity in certain regions in early times, or climatic conditions more suitable for the preservation of the meteors. The article also deals with cometary physics, and points out the inadequacy of mutual friction of particles to supply the violent expulsive force that was demonstrated to exist in the envelopes of Morehouse's comet; no solution of the difficulty is arrived at.

THE ORBIT OF ZETA HERCULIS.—This star has been a favourite object for double star observers owing to its short period and the brightness of both components. It has now completed three revolutions since discovery, and materials exist for a very accurate orbit. It is discussed very fully by E. Silbernagel in *Astr. Nach.* 5578. He studies the systematic errors of the observers. His final period is 34·417 years, the eccentricity being 0·455 and the semi-major axis 1·349″. There is some evidence of a progressive movement of the node of 1° in 10 years. Adopting a parallax of 0·100″, the masses of the components are 1·35 and 0·73 of the sun's mass. The diameter of the principal star is given as 2¼ times the sun's, its density one-tenth of the sun's. Some people have suspected an invisible companion from supposed irregularities in the motion; the author does not think that the evidence requires this.

Research Items.

MUMMIFICATION IN AUSTRALIA AND AMERICA.—Mr. Warren K. Dawson has published in the *Journal of the Royal Anthropological Institute*, Vol. 58, Pt. 1, a study of the characteristic features of mummification as practised in Australia and America, based partly upon the published evidence, and partly upon a personal examination of such of the actual mummies or their photographs as are available—the latter a point of importance, as it has enabled the author to meet the contention, maintained by many writers, that mummification in South America is a result of natural causes, as it undoubtedly was in the early period in Egypt. In Australia the object of mummification was to secure the preservation of the body until the prolonged ceremonies after death had been completed. Hence it was necessary that the body should be portable owing to the frequent moving of the camp. The body was, therefore, preserved in a position which was often unnatural, the thighs sometimes being so far bent that the knees were forced behind the shoulders. Certain features which are meaningless in their context point to an introduced ritual. Such, for example, is the practice of mummification even when the corpse was destined for cremation or other form of destruction; the pains taken to remove the epidermis, though the whole of the body was afterwards burnt; the laying of the body on a roof-covered platform, and the painting of the body with red ochre and the attempt to give it a life-like appearance by painting the shrunken eyes. In Egypt by the twenty-first dynasty an artificial eye of white stone with black inlay had superseded various experimental methods. In the Torres Straits artificial eyes resembling those of Egypt, sometimes cowrie shells, were employed. The Australians, lacking the necessary skill, sometimes packed the eyelid with cotton, indicating the pupil by a pigment.

POTTERY-MAKING.—Some interesting suggestions as to the development of technique in pottery-making are made by Mr. E. W. Gifford as the result of a study of the distribution of the methods employed in making pottery by hand among the Indians of the S.-W. United States ("Pottery-making in the South-West," *University of California Publications in American Archæology and Ethnology*, vol. 23, No. 8). The criterion of method is the use of a wooden paddle and stone or pottery anvil in shaping the vessel, the anvil, which is usually of mushroom shape if made of pottery, being applied inside, while the paddle is used to pat or tap the outside. In the south-west the unaided hand method of coiling is that of the Pueblo tribes and the Navaho; the anvil and paddle are found among the Yuman, Shoshonean, and Piman tribes. Outside the special area under investigation, the non-paddle method of coiled pottery is that of America from the Alaskan shore of Bering Straits to Argentina, the negro portion of Africa, and is found sparingly in Oceania. Pottery anvils occur in the Middle and Upper Mississippi Valley, as well as in the Lower Colorado River Valley, being discontinuous in distribution. The paddle and anvil technique is also found in the north-west of India, Assam, and extends from south-east Asia through Malaya into Melanesia, but is not found in Africa. The investigation supports the independent development of pottery in the Pueblo region, and justifies the belief that the non-paddle method is the older so far as the south-west is concerned. Though it is possible that Pueblo pottery had a northern Asiatic origin, the potteryless area of northern North America is an objection. The paddle and non-paddle methods may represent earlier and later diffusions from the old world. The areas of distribution of the three types of pottery-making, anvil, paddle, and non-paddle, show the paddle as intermediate and the non-paddle as peripheral, which would point to the seat of the invention in the central area of the potter's wheel, *i.e.* that in which Egypt and Mesopotamia are situated. On the other hand, the non-paddle coiling might have been invented independently in Africa, Eurasia, and America, while the paddle method was invented both in Asia and in America. The wheel being invented in the Old World did not spread to America until the coming of the peoples of higher culture.

JUVENILE SPECIMENS OF THE LUNG-FISH.—Apart from specimens raised from ova, in which the maximum period of survival was two years, no juvenile Queensland lung-fishes have been seen, until in February 1928 seven young specimens of *Ceratodus* were discovered hiding amongst water weed in the Enoggera Reservoir near Brisbane. They were found accidentally during the clearing of weed from the reservoir. Heber A. Longman gives a summary of the literature bearing upon *Ceratodus* and describes the appearance and habits of the young individuals, which are now living in one of the large aquaria in the Queensland Museum (*Mem. Queensland Mus.*, vol. 9, part 2, 1928). The specimens measured from 96 mm. to 150 mm. in length. As a rule they breath through their gills at a rate of about fifteen inhalations a minute, although when they are disturbed the rate may be increased to at least sixty-eight times. The lung is very rarely used in normal conditions in the clear water of the aquarium during the day-time. The fish are most active at dusk and during the night, and although for the most part they are extremely sluggish and torpid, when disturbed they dart from end to end of the eight-foot aquarium with extreme rapidity. Their eyesight appears to be very poor, and they seem, unlike most fishes, to be insusceptible to vibrations. They are fed upon live worms and shredded pieces of raw beef, but have been seen apparently feeding upon algal growths on the water-weeds in the tank.

NORTHERN KINORHYNCHA AND TARDIGRADA.—Lieferung XI of "Die Tierwelt der Nord- und Ostsee" (Akademische Verlagsgesellschaft m.b.H., Leipzig) contains good accounts of these two curious and interesting groups. The Kinorhyncha (VII. d_2), described by Adolf Remane, are minute animals living on mud and ooze on the sea bottom and on marine algæ. Dr. Mortensen has recently (1925) constructed a special net for collecting such organisms, which should prove extremely useful. Many species are only known in the larval condition and few have been seen to change into the adult. Before the last change takes place the animal may be sexually mature. Three orders, five families, and six genera, besides some forms not known in the adult state, are recognised from this area. All are minute, ranging from 180 μ to 1 mm. in length. They are elongated, bilaterally symmetrical animals, with 13 segments (rarely 14). There is a strong spinous cuticle with an anteriorly protruding proboscis reminding one of *Echinorhynchus*, at the apex of which the mouth opens. A true cœlom and blood system are apparently absent. The Tardigrada, by G. Rahm (XI*b*), contains a survey of the marine forms. Some are commensals or parasites on echinoderms, others occur on the sea bottom or above high-water mark. The capacity in the land forms for reviving after prolonged desiccation is well known, a dried-up ball

on being moistened soon becoming an active animal, and it is now known that the marine species act in the same way. No true metamorphosis takes place, the young being like the adult, but changing its skin frequently. Both the Kinorhyncha and the Tardigrada are now regarded by many as akin to the annelids, the former group being at one time placed near the rotifers, the latter, as in the present work, near or with the arthropods. Their affinities are very difficult to determine, and much more work is required before the question can be settled. Both groups offer a fertile field for marine zoologists.

INFECTION WITH MALE SCHISTOSOMES ONLY.—E. C. Faust (*Jour. Parasitology*, **14**, p. 62; 1927) records the presence of male schistosomes alone in experimental infections. Ten thousand living snails (*Oncomelania hupensis*), all found in the vicinity of Soochow at five periods from March to September 1926, were gently crushed one at a time, and twenty were found to be infected with the cercariæ of *Schistosoma japonicum*. Rabbits or dogs were submitted to infection with hundreds of mature cercariæ, but when examined post mortem from one and a half to five months later, only immature male worms were found. From 33 to 165 worms were present in the respective hosts, and a total of 725 in the nine hosts infected, and all the worms were male. In previous experimental infections from snails collected in the Soochow area no consistent series of only male or only female worms has been obtained. According to Cort's hypothesis (1921), that sex is differentiated in the miracidium stage and that all cercariæ which develop from a single miracidium are of the same sex, the results recorded would indicate that the snails were parasitised only by male miracidia, but it is conceivable that the dry conditions prevailing in the area may have been more severe on the female than on the male parthenitæ in the snails. Natural human infections acquired under such conditions might have consisted of male worms only, and hence could not have been diagnosed by the finding of eggs in the fæces. While such infections would not have the same destructive action on the liver and intestinal tract of man as those produced by males and females resulting in the extrusion of eggs into the tissues, if the males were numerous they might obstruct the mesenteric radicles and their secretions occasion an appreciable eosinophilia. Suspected schistosome infections in endemic areas where stool examination is consistently negative might be studied in the light of these experiments.

TEMPERATURE AND ELECTRICAL STIMULATION OF PLANT TISSUE.—In a recent paper, Dixon and Bennet-Clark discuss evidence for the belief that the electrical conductivity of a tissue is largely due to the permeability of the protoplasmic membranes of the component cells to ions, and that a change in conductivity is due to and proportional to a change in the permeability of the protoplasts (*Sci. Proc. Roy. Dublin Soc.*, vol. 19 (N.S.), No. 4). Their experiments show that there is a continuous change in conductivity with a continuous increase in stimulation until stimulation becomes lethal, and it is supposed that the rise in conductivity due to smaller stimuli is of the same kind as the rise observed with lethal stimuli. Some experiments on leaf tissue of *Hedera helix* showed that there is marked seasonal variation of sensitivity, seemingly unaffected by the temperature obtaining at the time of gathering the leaves. In spite of this, however, the temperature of the tissue when stimulated has a very profound effect upon the response. In general, rise in temperature brings about a decrease in resistance, and at temperatures between 20° and 35° C. a change of 1° may alter the magnitude of the response as much as ten per cent. At the temperature of 50° C. and upwards, the resistance never assumes a steady value, but decreases continually with time until the resistance characteristic of a dead and completely permeable tissue is attained.

THE SHIMABARA (JAPAN) EARTHQUAKE OF SEPT. 8, 1922.—A recently issued *Bulletin of the Imperial Earthquake Investigation Committee* (Tokyo) (vol. 10, No. 2), contains three brief notes on this important earthquake, one by the late Prof. Omori and two by his successor, Prof. A. Imamura. The Shimabara peninsula projects from the coast of Kiushiu, the southern island, and contains in its centre the great active volcano, Mt. Unzen. There were two strong shocks, the earlier and stronger at about 1.50 A.M., the other at about 11.3 A.M. As they originated in centres about 4½ miles apart, Prof. Imamura regards them as forming a twin earthquake. Prof. Omori shows that they differed in two respects from ordinary volcanic earthquakes. The depth of the focus was considerable, about 21½ miles, and the number of after-shocks was unusually great, amounting by noon on Sept. 11 to as many as 1417. A few months after the earthquake, a new line of levels was run along the north and east coasts of the peninsula, and a comparison with the earlier series, made about thirty years before, indicates a small but general rise of the peninsula by amounts ranging up to 8·3 cm. On the other hand, tidal observations made a few miles to the west point to a subsidence of 2 cm. or 3 cm. in about the same interval.

VISCOSITY OF PETROLEUM PRODUCTS.—This subject was dealt with in a paper of the Research Association of British Motor and Allied Manufacturers, by H. S. Rowell and D. Finlayson, read recently before the Institution of Petroleum Technologists. Actual needs of car practice were considered and the conclusions were regarded from the point of view of the user. The fluidity of motor fuels was measured, and from the results obtained it appeared possible that viscometry, combined with densimetry, would be an effective method for the analysis of complex fuels. The authors have extended our knowledge of viscosity-temperature curves of lubricating oils into the relatively unexplored regions beyond 150° C., and they have proposed a new viscosity characteristic, viscosity multiplied by $\left(\frac{t+10}{100}\right)^3$, where t is temperature in degrees centigrade, in order to show more clearly ratios of the viscosities of different oils at the same temperature and the extent of difference in the viscosity-temperature variation of different oils.

STRONG ELECTROLYTES.—The outstanding flaw in Prof. Debye and Dr. Hückel's theory of strong electrolytes, that it leads in some cases to negative values for the ionic radii when compared with experiment, is removed in a paper published by T. H. Gronwall, V. K. la Mer, and K. Sandved in a recent issue of the *Physikalische Zeitschrift* (No. 12). Previous attempts to explain the anomaly had proceeded on the lines of a revision of some of the fundamental physical assumptions, but it is now shown that the error has actually been in the mathematical development, an insufficient number of terms having been employed in a certain series. The analysis involved is exceptionally heavy, but has been followed through with satisfactory results for dilute solutions of the ions produced from salts such as potassium chloride and zinc sulphate, and is to be extended to cases where the dissociation is unsymmetrical. In the following issue of the same

journal, Prof. Debye himself and H. Falkenhayn have extended the original theory to include the case of conductivity in alternating applied fields, when allowance is made for the Brownian motion of the ions.

THE INFRA-RED REGION OF THE SPECTRUM.—Sir Robert Robertson, J. J. Fox, and E. S. Hiscocks, in a series of papers published in the *Proceedings of the Royal Society*, Series A, vol. 120, No. A 784, p. 128, describe an experimental technique which permits of the employment of a rock-salt prism spectrometer for the determination of the fine structure of absorption bands in the infra-red region. They have applied this technique to the measurement of the absorption spectra of the gases ammonia, phosphine, and arsine. The oscillation bands found for these gases show definite series relationships. The main sequence of bands obeys approximately the relation $\nu = n\nu_0$, but the Kratzer relationship, which applies to dipoles, does not hold here. In all three gases, the wave number of the fundamental is much lower than expected. The ratios of the wave numbers of corresponding bands for any two gases are constant, indicating that the unit mechanism which accompanies the absorption process is similar for the three gases investigated. The oscillation of the molecule becomes slower as the mass increases. Two other sequences of bands are present, there being a close resemblance between the bands for arsine and phosphine. In the ammonia spectrum, there is found a band at $10 \cdot 55\,\mu$ which is unique. From the fine structure of a number of these bands, the moments of inertia and the radii of gyration of the molecules have been calculated. There is a constant ratio between the radii of gyration and the half diameter of the mean collision area of these gases found by Rankin, the radii increasing with the mass of the molecule. The researches have brought to light new types of rotation-oscillation bands which are characterised by the presence of very pronounced maxima in the centre of each band. It is not clear whether these maxima are due to zero branches of a hitherto unknown type or whether the bands are composite in character. A molecular model for ammonia, phosphine, and arsine is put forward tentatively. The experimental data are best interpreted on the assumption of a tetrahedral model.

THE QUANTITATIVE DETERMINATION OF HÆMOGLOBIN.—A large number of methods have been evolved for the quantitative determination of hæmoglobin, but practically all of them suffer from the disadvantage that the final result depends upon the comparative judgment of tints between a standard and the sample solution by the naked eye. In a recent paper published by the Institute of Physical and Chemical Research, Tokyo, K. Uchiyama describes how the silver iodide photoelectric cell may be utilised for the estimation of hæmoglobin. Three methods of procedure are explained, and these were found to yield satisfactory results. In the same way, the concentration of the colouring matter in any solution absorbing light to which the cell is sensitive may be determined.

CONDITION OF SPARINGLY SOLUBLE SUBSTANCES IN GELATINE.—Sparingly soluble substances, such as silver chloride or lead iodide, when formed in the presence of a gel, are sometimes considered to exist in the supersaturated condition. Results obtained by A. C. Chatterji and N. R. Dhar have shown that this view is probably incorrect and that these substances are mainly present in the colloidal state. This conclusion is based on conductivity measurements, and further results to support it are published in the *Journal of the Indian Chemical Society* (vol. v. No. 2). Silver chloride was formed in gelatine solution by the addition of equivalent quantities of silver nitrate and potassium chloride, and the results indicated that if the silver chloride were present in the ionic condition its conductivity should have been much greater than that actually found. Chatterji and Dhar also consider that results obtained by Bolam and Mackenzie (1926) with silver chromate and gelatine support the above conclusion.

THE DIELECTRIC POLARISATION OF LIQUIDS.—The calculation of the electric moments of molecules from dielectric constants is of considerable value in the elucidation of molecular structure, but this calculation cannot be applied in the case of molecules which are surrounded by strong fields of force, and in such cases it is necessary to use solutions in which the molecules with strong fields of force are surrounded by molecules with weak fields. An investigation of the dielectric constants and densities of solutions of the chlorobenzenes in benzene and hexane is described by C. P. Smyth, S. O. Morgan, and J. C. Boyce in the *Journal of the American Chemical Society* for June. A capacity bridge was used for the dielectric constant measurements. The results indicate that the molecules of the chlorobenzenes tend to orient themselves in such a way that neighbouring doublets oppose one another and thereby decrease the polarisation. This effect is most marked with molecules which have high electric moments, and increases with the concentration but decreases with rise in temperature. In a second paper in the same journal, Smyth and Morgan describe the results of the measurement of the dielectric constants of solutions of ethyl bromide, chloroform, and chlorobenzene in hexane over the entire range of temperature and concentration within which the mixtures are liquid. These data have been used to obtain approximate values for the polarisation due to shifts of atoms and groups within the molecule and also to obtain accurate values for the electric moments. The validity of the Debye equation for the variation of dielectric constants with temperature as applied to liquids at infinite dilution, was also verified.

A NEW TYPE OF TUNGSTEN-FILAMENT LAMP.—Attention is directed in the *Chemiker-Zeitung* for July 25 to a new German patented process for producing tungsten filaments for incandescent lamps, which are capable of producing much more intense illumination than has hitherto been possible. The process depends upon the formation of long single-crystals of the metal, which differ considerably in properties from the ordinary polycrystalline variety. They are not disintegrated at high temperatures like ordinary filaments and consequently they do not blacken the inner surface of the container. The preparation of such long or single crystals in the form of threads was described in 1926, and many attempts have been made to utilise this material in the form of coils for incandescent lamps. Hitherto these attempts have been unsuccessful, owing to the tendency of the bent single-crystal to revert to the polycrystalline condition during the burning of the lamp. This tendency, which appears to be due to the mechanical strain involved in wrapping or coiling the filament, has apparently been successfully overcome at the Technische Hochschule in Dresden, and it has been found possible to construct 5 kilowatt and 10 kilowatt lamps with an average intensity of 8000 candle-power, although a maximum intensity of 60,000 candle power is said to have been attained. The lamps have a life of 800 burning hours, and a company has been formed in Dresden for the purpose of manufacturing them. They are likely to replace arc-lights for many purposes in industry.

Regulations for International Radio Communication.

THE regulations that were arrived at by the International Radiotelegraphic Convention at Washington in November 1927 have now been published by H.M. Stationery Office (price 2*s*. 6*d*.). It is satisfactory to find that the regulations, although naturally somewhat complicated, were signed by the eighty governments which took part in the convention. They start with the definition of what is meant by 'radioelectric communication' or radio communication. It includes the transmission of writing, signs, signals, facsimiles, and sounds of all kinds by Hertzian waves. The International Bureau of the Telegraph Union is charged with the duty of collecting information of all kinds in connexion with radio services and of doing work for the international radio services.

Radio 'emissions' are divided into two classes, *A* and *B*, which consist of continuous waves and damped waves respectively. Class *A*, continuous waves (*C.W.*), are further subdivided into *A*1—the unmodulated waves which can be varied by a telegraphic key; *A*2, comprising the *C.W.* which are modulated at ordinary frequency and can be varied in a periodic manner at audible frequency; the final subdivision, *A*3, consists of *C.W.* waves modulated by speech and music. No new broadcasting station shall be authorised to work in the band of frequencies between 160 and 224 kilocycles (kc.), that is, between wave-lengths of 1875 and 1340 metres.

A full syllabus of the knowledge required by radio-telephone operators before they are granted the necessary certificate is given. The distress call has absolute priority over all other signals, and all transmissions which might interfere with it must immediately cease. This rule also applies to a radio-telephone distress call which consists merely of the spoken expression 'mayday,' which corresponds apparently with the French pronunciation of *m'aider*. In order to increase the safety of life in ships and aircraft, all stations in the mobile maritime service must watch for the distress wave 500 kc. (600 m.) from the 15th to the 18th minute and from the 45th to 48th minute after every hour, Greenwich mean time.

For mobile stations the use of damped waves is restricted to eight frequencies lying between 375 kc. and 1364 kc. (800 m. and 220 m.), but the use of one of these types, 665 kc. (450 m.) is forbidden in all regions where it interferes with broadcasting. The term radio beacon (radiophare) is confined to those stations the emissions from which enable the receiving station to determine its bearing. A direction-finding (radiogonoiometric) station means one provided with special apparatus to determine the direction of the emissions from other stations. The words 'phare' and 'gonio' are always shown after the name of radio beacon and direction-finding stations respectively. It is to be noticed that administrations which have organised a radio beacon service accept no responsibility for errors due to utilising it.

In an appendix, international radiotelephonic procedure is described. The formulæ for calling and cutting off are given in French or English and are very familiar to many amateurs. In French, if *A* is calling *B*, he says, 'Allo *B*, allo *B*, *A* appelle, *A* appelle, Message pour vous, Message pour vous, over.' The 'over' seems to be English. In breaking off the communication, *A* replies, 'Allo *B*, *A* répond, exact, exact, coupant.' 'Coupant' means switching off. For land stations the geographical names are employed, but for mobile stations the radio call signs are used.

The Management of Small Woodland Areas.

IN matters pertaining to forestry, both the preservation of existing woodlands and reafforestation, the various States comprised in the United States of America hold varying positions and outlooks. Some are unquestionably facing the question in the spirit which its undoubted economic importance to the nation and to the individual States requires. The State of Illinois affords a striking illustration. A recent *Bulletin* (vol. 17, article 2, 1927) issued by the State Department of Registration and Education, Division of Natural History Survey, is entitled "A Manual of Woodlot Management," by C. J. Telford. This manual is addressed to those landowners who have woodlots (*i.e.* woodland areas) or idle land. "It is assumed," says the author, "that they appreciate the intangible benefits accruing from the woodlot as a refuge for wild life, as a local modifier of dry and cold winds, as a protection to the sources of local water supply, as a means of enhancing the beauty of the landscape, and as a place for recreation; and that they also appreciate the service to the nation rendered by productive forests." These are large assumptions upon which to base a manual of forestry, and the past history of most countries has shown but too often that, taken collectively, such an assumption has not been borne out by the reality. This being said, it will not be the author's fault if the landowners of Illinois do not realise some of the benefits which the application of the recommendations of this manual place it within their power to achieve.

Briefly, Mr. Telford commences by defining the true forest lands in the State, outlines the methods for the proper management of the woodlot, and gives the general returns to be anticipated from the managed production of wood. The point kept in view in the treatment of the subject is the growing of a wood crop for the production of revenue. In part the manual is a simple text-book on sylviculture, but the author goes further afield and discusses the methods adapted to the growing of timber in this particular State under different conditions of site and market, and the methods of measuring and marketing the products. Space precludes the possibility of dealing at any length with this little book, but attention may be directed to one or two aspects. The first is that the author confines himself entirely to the State of Illinois itself: the different soils, types of existing forest, the species occupying different areas, and those most suitable for replanting felled areas or blanks in existing woods or afforesting waste lands, and so forth. In other words, the work is a practical effort at providing the owner of woodlands or waste lands with the information necessary to improve their condition or plant them up, estimates of values and markets for different classes of materials being based on the existing and prospective demands within the State. Herein lies the value of the manual.

The author's recommendations are further assisted by the offer of the State Natural History Survey to help woodland owners with practical advice from the State officers as regards management. In this connexion the aims pursued by the Natural History Survey are given (in Appendix F) as follows: (*a*) To take account of the value of woodlands, existing or

proposed, for recreational uses, not only by the inhabitants of the larger cities of the State, but also by the country people and the inhabitants of the smaller towns whose home surroundings are often oppressively monotonous; (*b*) to consider the uses of forests as reserves of the primitive life of the State, of great interest and value to the student of science and his teacher and to the lovers of wild life; (*c*) to co-ordinate the forest policy of the State with the movement for the establishment of a system of State parks.

A study of this manual and the appendices may be recommended to all interested in the progress of afforestation in Britain and in the development of a forest policy on sound lines.

Mountain-Building Movements and the Genesis of Petroleum.

By HENRY B. MILNER.

THE influence of mountain-building movements on oil migration and accumulation has long been recognised, and is so plainly manifest in different petroliferous provinces all over the world, that it has become one of the least controverted theories in the general hypothesis of oil occurrence. In the past decade, the teachings of the Alpine school in Europe have especially helped to clarify this relationship, and developments in the oilfields of Galicia, Rumania, Iraq, Persia, Burma (to cite only a few) are constantly impressing us with its significance.

An unorthodox, and to some extent novel, aspect of the matter is viewed by Mr. John L. Rich in a paper entitled "Generation of Oil by Geologic Distillation during Mountain-Building,"[1] in which he follows more or less similar ideas put forward by Bailey Willis some years ago. He starts off with the fact that in regions of intense mountain-building movements, carbonaceous shales are seen to have lost their 'kerogen' or oil mother-substance, such hydrocarbon, however, being present in equivalent rocks without the metamorphic zone. The destiny of this 'lost' petroleum is traced in accordance with the latest theories of orogenesis, though not entirely by stages usually recognised in this particular natural history.

Rich defines at the outset his geosyncline, with its accumulation of thick series of bituminous sediments under deposition (conventionally) in a sinking basin. The next phase is mainly orogenic, concerned with the piling up of thrust-sheets *over* (the italics are mine) the geosynclinal sediments, this accompanied by a kind of synclinorial folding of the sediments beneath the nappes, further by the inevitable isostatic sinking. During this stage oil is generated by heat and dynamic movements, apparently beneath the nappe zones, the environment simulating that of a "giant high-pressure cracking still." There follow successively peneplanation and further unwarping of a regional character, and finally the delineation of three distinct zones. Zone 1 is the zone of distillation, *i.e.* intense dynamic metamorphism, where the bituminous rocks have suffered devolatilisation, carbon ratios are high, and possibly only small quantities of gas remain. Zone 2 is the zone of partial distillation, and what Mr. Rich calls *in situ* accumulation. In this zone the rocks are partly devolatilised, carbon ratios are medium, and oil is plentiful. In Zone 3 the unaltered rocks occur, and the influence of active dynamic distillation has not been felt; consequently carbon ratios are low, oil is scarce, and what there is of it has probably migrated either during orogenic movement or afterwards in response to hydraulic factors.

Thus it will be gathered that the author arrives at the explanation of this type of oil-pool in a somewhat different manner from that often given; also, he ascribes considerable importance to the upwarp phase, when rocks formerly subjected to distillation are exposed to inflow and artesian circulation of meteoric waters, causing extensive secondary migration of the oil. This putting of 'the cart before the horse' is probably the most contentious part of the theory. On the other hand, if there is anything in the hypothesis, then contiguous deposits to areas of carbonaceous shale occurrences, given the requisite evidence of earth-movement on a large scale, should be worth inspection for oil, undoubtedly an invigorating prospect. The author cites the Oklahoma-Kansas-Missouri-Iowa region as his example; possibly the reader may call to mind another.

[1] *Bull. Amer. Assoc. Petroleum Geologists*, vol. 4, pp. 1139-1149; 1927.

Herring Food.

DR. P. JESPERSEN, in an important memoir, gives a detailed account of the food of the herring in Danish waters ("Investigations of the food of the Herring in Danish Waters," *Meddelelser fra Kommissionen for Havundersøgelser*. Serie: Planton. Bind 2, No. 2. 1928. Copenhagen). This was undertaken at the instigation of the International Council for the Investigation of the Sea, and is part of a general scheme for working out the biology of the herring in different countries of Northern Europe.

The research is based on the examination of the stomach and intestine contents of a large number of fishes at different stages of development, with special reference to the diet during growth from larva to adult, noting variations in the nature and quantity of the food in different waters and at different seasons. More than 7000 fishes were examined, nearly 3000 of which were young stages between 4 mm. and 50 mm. in length, the remainder being adolescent and adult.

The results of the examination of the larval and young stages agree with former observers. It is found that those retaining the yolk are able to feed, although there is less food (chiefly green remains) inside them, in proportion to their size, than in the post-larvæ. After the absorption of the yolk sac much more food is taken, the size and amount of food increasing with the size of the fish. Phytoplankton and very small zooplankton is found in the smallest fishes, larger copepods and other small planktonic animals in those of larger size. Copepods predominate, especially *Temora longicornis* and, next in importance, *Pseudocalanus* and *Paracalanus*. The young herring 6-17 cm. in length, feed largely at all seasons, chiefly on copepods, but also at times on cladocerans, polychætes, *Sagitta*, and appendicularians. The adult herring 17-30 cm. in length, feeds mainly on Crustacea, but there is a considerable variation in its food according to season and locality. In the breeding season herring eggs are often eaten. In most localities, as has been shown by previous workers, spawning herring as a rule do not eat, although occasionally one finds full herring and those actually spawning with a large amount of food inside. Here they have been found to contain a considerable quantity of food,

especially the mature spawning herring. The young herring eat more than the adults; the relative number eating is greater and also the average number of organisms eaten per herring. The food varies in the herring from the four localities investigated. It is striking that no euphausiids, important as herring food elsewhere, find a place amongst the food of the Danish herring.

The whole work shows clearly that different food is eaten in different localities and different seasons, that different-sized herrings eat different sorts of food, and that adolescent herrings eat more than the adults. Also that copepods as a whole are the most important organisms in the food of the herring from Danish waters.

This memoir embodies a very large amount of work clearly stated, and is a most valuable addition to the literature rapidly accumulating on the biology of the herring.

Genetics of 'Bar-eye' in *Drosophila*.

THE allelomorphic series of mutations in *Drosophila* known as bar-eye and ultra-bar have been much investigated owing to their variability in the number of ommatidia present. It has been shown, for example, that increasing temperature (15° C. to 31° C.) causes a decrease in the number of facets which is of an exponential or linear order; and that this rate of decrease is more rapid in bar than in full eye, and most rapid of all in ultra-bar. Flies which are heterozygous for any of these genes are intermediate in mean facet number between the corresponding homozygous parents developed at the same temperature; but they approach more nearly to one parental condition than to the other, so that one of the conditions may be considered dominant. Near 27° C. is a critical temperature at which change of dominance takes place. Others have shown that at or near this temperature, growth and rate of development both cease to be accelerated. A rise in the frequency of crossing-over in the second chromosome has also been shown to take place at about this temperature, as well as the maximum amount of muscular contraction from a certain stimulus.

These results indicate that some general protoplasmic reaction is involved. More recently, Mr. A. H. Hersh (*Jour. Exptl. Zool.*, vol. 47, No. 2) has shown that in crosses of the bar series the Mendelian dominance differs in the reciprocal crosses as well as with the temperature at which the larvæ were reared, 27° C. being a critical point. He concludes that the cytoplasm of the egg plays some part in determining the size of the eye. Unlike reciprocal hybrids have long been familiar in *Œnothera*, but very few cases have been described in animals. It is suggested that characters in general may form a series with a few at one end determined solely by the cytoplasm, many at the other end determined wholly by the nuclei, and some between, such as the bar series, determined partly by both.

In another paper (*Jour. Exptl. Zool.*, vol. 50, No. 2) Mr. Hersh has analysed further the bar series. Zeleny showed that the compound eyes of such flies have a dorsal and a ventral lobe, which also shows in flies with full oval but mosaic eyes. Such bilobing is common in Diptera and occurs in other insects. Mr. Hersh shows that in the bar series, with increasing temperature, the number of facets in the ventral lobe decreases faster than in the dorsal lobe, and suggests that the optic stalk forms the line of separation between the two lobes. It is concluded that the genes of the bar eye series produce their effects by altering the distribution of growth in the developing organism.

University and Educational Intelligence.

LONDON.—The Connaught Hall of Residence (14 Bedford Place, W.C.1), recently presented to the University by His Royal Highness the Duke of Connaught, will be ready for students of any of the colleges and 'schools' of the University at the opening of the session in October.

THE University College of Wales, Aberystwyth, has established a Travelling Scholarship Fund which is used for the purpose of enabling members of the staff and students to visit foreign countries for the purpose of extending their studies. The grants made are quite small, generally £10, but are, the Council reports, greatly appreciated. Last year seven members of the staff, three past students, and forty students received such grants.

"ACCREDITED HIGHER INSTITUTIONS," a pamphlet issued as *Bulletin*, 1927, No. 41, by the United States Bureau of Education, shows that in the absence of any central controlling authority a fairly complete system for standardising educational institutions has been evolved by voluntary associations. It gives lists of institutions of higher education accepted by certain national and regional associations as meeting their standard requirements. Most of these requirements are set out in full, as are also the college, junior-college, and teacher-training college standards of the American Council on Education, which took the initiative in formulating standards for general adoption in accrediting institutions, but is not itself an accrediting agency. The other associations are: the Association of American Universities, five regional (Middle, Southern, North Central, North-Western, and New England) Associations of Colleges and Secondary Schools, the American Associations of Junior Colleges and of Teacher-Training Colleges, and a number of professional associations. Of fully accredited professional schools there are 71 medical, 26 dental, 53 pharmacy, 65 law, and 15 librarianship.

THE Council of the City and Guilds of London Institute has recently issued a report for 1927—the forty-eighth annual report since its incorporation. Of its three departments, namely, the City and Guilds (Engineering) College at South Kensington, the City and Guilds South London Technical Art School, and the Department of Technology, the first, which is the largest of the three colleges constituting the Imperial College of Science and Technology, was attended during the year by 506 students. Notwithstanding the continued depression of the engineering industries, the number of entries to the college is maintained, thanks to anticipations of a growing demand in the near future for electrical engineers. Of the 188 candidates for admission, 34 (more than twice as many as in the preceding year) came from schools outside Great Britain: 23 were from India. A very large proportion of the students, nearly 40 per cent, were scholarship holders, the total sum awarded by external authorities to students during the session being £16,346. Post-graduation classes in electrical engineering, the value of which has been recognised by industrial firms, increased notably, and 14 students were awarded the post-graduation diploma of the Imperial College. Since the formation of the Imperial College Appointments Board, 728 engineering students have been registered, of whom, so far as is known, only 17 are unemployed.

Calendar of Customs and Festivals.

September 16.

THE SAKAIA.—The ancient Persians celebrated a festival called by Greek writers τὰ Σάκαια, the Sakaia, attributing to it a Scythian origin. Varying accounts are given of how it arose. It seems possible that it was of Babylonian origin. The festival of the Sakaia at Babylon, according to Athenæus, took place on the sixteenth day of the month corresponding to the Attic Boedromion (September). At this festival, Athenæus says, the masters were ordered about by the slaves, one of whom governed the house, and was clothed like a king. In the Persian festival a condemned criminal was clothed like a king and allowed to rule the land, drink and misconduct himself with the king's wives; but afterwards he was taken away, scourged and hanged. In the spring festival at Babylon the king's insignia were taken from him, his ears were pulled and his cheek smitten.

THE ABBOT'S - BROMLEY (STAFFORDSHIRE) HORN DANCE.—This dance takes place on the Monday following the first Sunday after Sept. 14. It is still recognised as a solemn ceremonial and is danced in all seriousness, although a certain amount of licence is allowed the buffoon. The accessories, the reindeer horns, the ladle, and the bow and arrow, hang all the year round in the church, and the dance starts in the morning from the church after receiving the benediction of the vicar. The dancers are twelve in number, one being a boy who carries the bow and arrow. There are two musicians, a fool, a hobby-horse, a Maid Marian with the ladle, and six dancers who hold the horns on their heads as they dance.

This dance has an unbroken tradition of four hundred years, but is of course much older, and, so far as appearances go, might well be descended from the horned dancer painted in palæolithic times on the walls of the cavern of Les Trois Frères at Ariège in the south of France. It is clearly closely related to the bear and other mimetic animal dances of the tribes of north-eastern Asia and North America. During the day the dancers cover a circuit of about fifteen miles, dancing at each house they visit, and finish up by dancing up the village street, while everyone watches from the house door to share in the good luck. Whether the dance is propitiatory, sacrificial, or a piece of sympathetic magic, is obscure. The circuit over which it is danced shows that it is intended to secure communal good luck. It is obviously a hunter's mimetic ritual, and is probably the most primitive of the survivals in Great Britain.

September 18.

ST. FERRICOL, A.D. 304, saint and martyr: a Roman tribune at Vienne who became a Christian. On refusing to sacrifice according to pagan rites, he was imprisoned. On the third day his chains fell from him and he escaped. He swam across the Rhône, but was captured and beheaded.

It was customary for the anniversary of this saint to be celebrated with great pomp at Marseilles. Triumphal arches were erected and the whole town and the ships in the harbour decorated with flags. Gardeners and butchers took a prominent part in the procession which took place, proceeding to various altars and resting places which were decorated with flowers. The gardeners carried wax tapers, green boughs, flowers, and banners. The butchers wore long cloaks, bonnets of sixteenth century type, and bore cleavers. They led a fat ox decked with garlands and covered with a carpet on which sat a child as John the Baptist. The ox was led about for a week before the festival, bringing good luck to houses at which it left a trace of its visit. It was killed the day after the feast. Young girls representing nuns, saints, and the Magdalen, and boys dressed up as saints and priests, took part in the procession. The streets were strewn with flowers, which were also scattered on the bystanders. The procession proceeded to the port where all the ships were manned, and a special service of benediction took place.

September 21.

ST. MATTHEW'S DAY.—The Lord Mayor of London makes the annual presentation of a guinea to the two senior Grecians of Christ's Hospital, more familiarly known as the Blue Coat School. From an account given in the journal of Richard Hoare, Sheriff 1740–41, it would appear that the governors of the other hospitals throughout the city also attended on this occasion in the hall of Christ's Hospital, and after the service, speeches from the boys in commemoration of their founders, and the presentation of guineas by the Lord Mayor, and half-guineas by the Sheriff, an inquisition into the management of the hospitals by their respective governors was held, the City Marshal giving evidence. While this was taking place, the beadles of each laid their staves on the floor and took them up only when the Lord Mayor had declared himself satisfied.

September 22.

At Beddinton a custom was observed of conveying in procession through the village a rabbit decorated with scarlet ribbons, while a hymn in honour of St. Agatha was sung—a ceremony traditionally dating from the first crusade. All men and young women who met the procession extended their first two fingers—a gesture familiar as a protection against the evil eye—and said:

> "Gustin, Gustin lacks a bier.
> Maidens, maidens bring him here."

HARVEST.—Water charms are sometimes found in connexion with the harvest home. In Hertfordshire the farmer drove the last load to the barn at full speed, while the people he passed pursued with bowls of water which they tried to throw on his cart. In the same county a scramble followed the making of the 'dolly,' and either the leader or the man who secured it in the scramble ran with it to the farmhouse and tried to get in without being drenched by the maid who stood ready to receive him with a bucket of water at the farmhouse door.

It was a common custom to appoint a leader of the reapers, the 'Lord of the Harvest,' who led in all the operations and in the ceremonial performances. In the Norfolk harvest home, previously quoted, there was also a second known as his 'Lady' who performed certain functions with him at the harvest supper, soliciting largess from the farmer's guests in disguise. It may be noted that in Bedfordshire the 'dolly' took the name of 'Jack and Jill.' A female character appeared at a later stage in the Norfolk supper, when one of the characters, donning female attire, was attacked by violent toothache, for which the doctor was summoned. He appeared riding on another as his horse, and the tooth, a piece of tobacco pipe, was extracted by a pair of tongs, which caused so much pain that the 'lady' fainted—a piece of buffoonery which, like the mumming plays, may hide something of more serious import, and be a faint remembrance of the human sacrifices of more primitive harvest customs.

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting, Liverpool), Sept. 5.—**R. May**: Eighth report to the Corrosion Research Committee. Further investigations of 'impingement attack' were undertaken to interpret the results of certain tests on condenser tubes, and, in particular, to explain the relationship which appeared to exist between the effects of intermittent cavitation in the water and the effects of air-bubble impingement. The behaviour of protective films under various conditions of impingement has been studied by measurements of the 'film potential.' When there is no intermittent cavitation, 'impingement attack' can still take place as a result of air-bubble impingement, and it is concluded that there are two separate main causes of 'impingement attack,' namely, intermittent cavitation as shown by Sir Charles Parsons, and air-bubble 'inpingement' as shown by Dr. Bengough, R. Pirret, and the author. Both depend on the occurrence of rotating motions of the water.—**Ulick R. Evans**: Corrosion at discontinuities in metallic protective coatings. The cracks produced by bending are more dangerous than uniformly distributed pores. If the coating metal is cathodic to steel, the steel is corroded; copper under some conditions causes marked acceleration of the corrosion of steel at exposed places, nickel being less dangerous. If the coating metal is anodic to steel, the coating suffers corrosion preferentially, the steel thereby receiving protection; thus steel coated with zinc usually suffers no corrosion even at cracks until the zinc becomes exhausted. Steel thickly covered with zinc usually fares better than thinly covered steel, notwithstanding the greater tendency to cracking; old galvanised sheet carried more zinc than the modern material and generally lasted longer. Coatings of aluminium or zinc-iron alloys are themselves less attacked than coatings of free zinc, but for that very reason they afford less sacrificial protection to the underlying steel in certain waters. Zinc itself is rather rapidly attacked when partially immersed in a chloride solution, but alternate salt-spraying and drying builds up a protective film.—**A. G. C. Gwyer, H. W. L. Phillips, and Miss L. Mann**: The constitution of the alloys of aluminium with copper, silicon, and iron. The ternary systems aluminium-copper-silicon and aluminium-copper-iron are considered. The former of these is eutectiferous, with a ternary eutectic of $CuAl_2$, aluminium and silicon, containing 26 per cent. of copper, 6·5 per cent. of silicon, and freezing at 525° C. The aluminium-copper-iron system is rather more complex; a peritectic reaction occürs at 590° C. between $FeAl_3$ and liquid resulting in the formation of a constituent isomorphous with 'X'; the latter forms a ternary eutectic with $CuAl_2$ and aluminium, containing 32·5 per cent of copper, 0·3 per cent of iron, and freezing at 542° C. A quaternary eutectic occurs at 26 per cent copper, 6·5 per cent silicon, 0·5 per cent iron, freezing at 520° C., the constituents being aluminium, $CuAl_2$, 'X,' and silicon. The paper deals exclusively with metastable conditions.—**C. J. Smithells, S. V. Williams, and J. W. Avery**: Laboratory experiments on high-temperature resistance alloys. A series of nickel-chromium alloys containing from 10 to 60 per cent of chromium, and a few ternary alloys containing tungsten and molybdenum, have been made from specially pure materials melted in hydrogen. For the binary alloys resistance to oxidation increases with increase in chromium content up to 30 per cent. With more than 40 per cent of chromium, a second phase appears and resistance to oxidation falls. Ternary alloys containing only 10 per cent of chromium show low resistance, while those containing 20 per cent of chromium show high resistance to oxidation. For high resistance to oxidation the oxide layer must contain at least 50 per cent of chromic oxide. The composition of the oxide layer is determined by, but is not generally the same as, the composition of the alloy. For the binary alloys resistance to sag at high temperatures decreases with increase in chromium content. The ternary alloys sag more than the binary alloys having a similar nickel content. Small amounts of impurities lower both the resistance to oxidation and sag.—**W. R. D. Jones**: The copper-magnesium alloys, Part 3. Notched-bar impact tests on forged and heat-treated copper-magnesium alloys are discussed. There is no advantage in adding more than about 2 per cent of copper to magnesium; alloys containing more than 5 per cent are brittle. The embrittling effect is decreased as the temperature rises. On exposure to cold, the toughness of those alloys has been decreased. Forging breaks down the eutectic network, improving the mechanical properties. Heat-treatment increases slightly the size of the globules of Mg_2Cu and the crystal grains, which are rendered equiaxed and more regular in size.—**J. E. Malam**: The Rockwell hardness test. The Rockwell ball test in its present form yields so-called 'hardness numbers' which are quantitatively misleading. Unscientific results are also obtained owing to the arbitrary numbering of the scleroscope scale. The whole subject of hardness testing should be examined by a representative committee.

Sept. 6.—**R. Genders, R. C. Reader, and V. T. S. Foster**: Die-casting of copper-rich alloys. Examination in the form of chill-cast bars and die-cast test-pieces has indicated that a variety of such alloys exists, suitable for die-casting and offering mechanical properties to meet varying requirements. The aluminium brasses have a wide range of properties, high proof stress, slow rate of attack on mould and core materials, and are cheap. Mould and core materials were tested by immersion in molten alloys; high-carbon steel and special steels of the heat-resisting type showed little deterioration, while low-carbon steel and engineering steels were rapidly attacked. The behaviour of cast iron in molten aluminium-bronze is largely influenced by the phosphorus content of the iron.—**S. L. Archbutt, J. D. Grogan, and J. W. Jenkin**: Properties and production of aluminium die-castings. Five alloys have been employed: namely, 4 per cent copper, 8 per cent copper, 12 per cent silicon, 4 per cent copper and 3 per cent silicon, and *Y*-alloy. Satisfactory castings were produced in the tubular form from all the alloys studied. With the test-piece form, castings of satisfactory mechanical strength were obtained in *Y*-alloy, 12 per cent silicon, and 3 per cent copper, 4 per cent silicon, but less satisfactory results were obtained with the binary copper-aluminium alloys owing to hot-shortness. In the investigation into hot-shortness the same five alloys have been studied together with *L* 5 alloy (copper 2·5-3·0, zinc 12·5-14·0 per cent). Hot-shortness is only exhibited at temperatures close to the temperature of commencement of melting; the range over which the rapid fall in impact strength takes place varies from 5° C. with the 12 per cent silicon alloy to 45° C. with *L* 5.—**T. F. Russell, W. E. Goodrich, W. Cross, and (in part) N. P. Allen**: Die-casting alloys of low melting point. Sixteen zinc-base alloys, having either copper and tin, or copper and aluminium, and—in some cases—with further additions of either nickel, cadmium, lead, or magnesium, have been examined. The copper-aluminium-zinc alloys are

approximately twice as strong as the copper-tin-zinc alloys. For any one alloy, the casting conditions—within reasonable limits—have only a small effect on the tensile strength when compared with the influence of the form of the test-piece, and of non-axial loading. The effects on the strength and on the permanency of dimensions, after atmospheric ageing, have been investigated, and tests of the so-called 'accelerated ageing' type have been made. The 'accelerated ageing' consists in subjecting the castings to the action of hot air, hot air saturated with moisture, and to steam at 100° C. Within the limits of the compositions examined, the effect of the chemical composition on the rate of growth is insignificant when compared with the effect of the *form* and mechanical condition of the actual casting.—**C. S. Smith**: The α-phase boundary of the copper-silicon system. The α-phase boundary has been redetermined by annealing and quenching experiments. The solubility reaches its maximum value, 6·7 per cent silicon, between 721° and 782° C. At 852° C.—the temperature of the peritectic horizontal the solubility is 5·25 per cent, while at 400° C. it is only 4·1 per cent silicon.—**C. H. M. Jenkins**: The strength of a cadmium-zinc and of a tin-lead alloy solder. Although a general similarity in type between the two materials was found, the cadmium-zinc alloy shows markedly higher values under the various tests. The tensile strength of the cadmium-zinc alloy as ordinarily determined is approximately four times that of the tin-lead solder, but under prolonged stress tests the values obtained are approximately six times as great. At 120° C. both materials show a diminished resistance to prolonged stress, the numerical values falling to less than one-tenth of those observed at room temperatures.—**G. B. Brook** and **H. J. Simcox**: Note on practical pyrometry. An instrument has been designed which eliminates stray currents and magnetic fields of great intensity and is accurate even when placed in the field surrounding a conductor carrying as much as 20,000 amp.—**F. Hargreaves** and **R. J. Hills**: Work-softening of eutectic alloys.—The micrographic changes on working and annealing the lead-tin eutectic afford an explanation of the existence of the critical amount of work observed at about 30 per cent reduction. A recrystallised sample of eutectic softens when the amount of work exceeds about 20 per cent, showing that softening is not a peculiarity of the eutectic structure but is due to the presence of two phases. Experiments on 0·5 and 15 per cent lead-tin alloys are described; the latter behaves very similarly to the eutectic, whilst the former may be rendered softer than the cast sample by working.—**William Hume-Rothery**: Methods for the thermal and microscopic investigation of alloys of reactive metals. Methods and materials are discussed. The method, introduced by the early German workers, in which the composition of a phase is deduced from the duration of the arrests of the cooling curves, whilst difficult to carry out, is sound in the case of simple eutectic arrests where no solid solutions are formed; but in the case of peritectic reactions, or where solid solutions are present, the method is by its very nature unsound at all except very high temperatures.—**D. R. Tullis**: Note on the treatment of aluminium and aluminium alloys with chlorine. Most aluminium alloys contain dissolved gases; the methods devised for their removal are: The slow solidification method, the inert gas method, the active gas method. Chlorine has been used as a means of removing dissolved gases and comparison is given between the slow solidification and the chlorine methods.

PARIS.

Academy of Sciences, July 30.—**Charles Moureu**, **Charles Dufraisse**, and **Antoine Willemart**: Researches on rubrene. Coloured hydrocarbons of the rubrene family. Two new hydrocarbons analogous with rubrene have been prepared, dimethylrubrene and dibenzorubrene.—**Gabriel Bertrand** and **Mme. M. Rosenblatt**: Potassium and sodium in marine algæ. The statement, due to Boussingault, that potassium is not present in *Fucus*, is shown to be inaccurate. Marine algæ are unequally sensitive to the action of distilled water: some, like *Pelvetia canaliculata*, retain their alkalis practically unchanged after repeated washing with distilled water, while others, such as *Padina pavonia*, lose their alkali salts rapidly under the same treatment.—**V. Grignard** and **J. Dœuvre**: The constitution of citronellol and of rhodinol.—**Alex. Froda**: Some descriptive properties of functions of real variables.—**S. Saks**: A theorem of M. Montel.—**D. Lagrange** and **D. Rosenthal**: The influence of the form of the ends of the elements of certain soldered joints on the value of the breaking load and on the deformation.—**A. Danjon**: The curve of light and elements of the photometric double star β-Lyræ. The mean curve of light (diagram given) is symmetrical, except in the immediate neighbourhood of the principal minimum.—**A. Gougenheim**: The use of the prism astrolabe for the study of the variations of latitude.—**Louis Kahn**: The astronomical determination of a point with the aid of a conformal map, utilisable as an orthodromic map.—**Jean Cichochi**: The conductivity of pulverised salts.—**Henri Muraour**: The relation between the temperature of explosion of a powder and its velocity of combustion. Experiments were carried out with explosive composed of equal weights of gun cotton and nitroglycerol, mixed with varying quantities of centralite (symmetrical diethyl-diphenylurea), in such a manner as to vary the explosion temperature between wide limits. It was found that the logarithm of the combustion velocity was a linear function of the explosion temperature.—**A. Sanfourche** and **L. Rondier**: Sulphonitrous and sulphonitric mixtures.—**G. Valensi**: The dissociation of chromium nitride. The nitride, of composition CrN approximately, was prepared by heating pyrophoric chromium with pure nitrogen at 800° C. The curves of dissociation of this substance for temperatures between 810° C. and 1000° C. are given.—**Mlle. Choucroun**: Rule relating to the diffusion of electrolytes in charged jellies.—**Jean Cournot**: Some cementations of steels by special alloys with a manganese base.—**Paul Dutoit** and **Armand Schnorf**: Calcium nitride. Studies on the various factors affecting the rate of combination of nitrogen with calcium, including the state of division of the metal, the catalytic effects of traces of impurities, and the effect of temperature.—**Ch. Mauguin**: The X-rays do not always give the true network of crystals. Examples drawn from the study of micas.—**Jacques de Lapparent** and **Ernest Stempfel**: Dehydrated gibbsite. Crystallised aluminium hydroxide on dehydration by heating does not leave an amorphous residue.—**G. Nadson** and **N. Krassilnikov**: A new genus of Endomycetaceæ: *Guilliermondella*.—**H. Colin** and **R. Franquet**: The genesis of starch in the bean.—**L. H. Dejust**, **Mlle. Van Stolk**, and **E. Dureuil**: The presence of ergosterol in human blood. The mixture of cholesterol and ergosterol was extracted from blood serum by suitable solvents and the presence of the latter demonstrated by means of its absorption spectrum.—**Swigel Posternak** and **Théodore Posternak**: The lability of the chains of serin-phosphoric acids and a general reaction for tyrines.—**A. Magnan** and

A. Sainte-Lague: A method of morphometry of fishes.—**A. Sartory, R. Sartory, Marcel Meyer**, and **Jacques Meyer**: Study of a new case of osseous mycosis.

GENEVA.

Society of Physics and Natural History, June 7.—**M. Minod**: A new stand for drawing in a camera clara. The author describes an apparatus based on the principle of the camera clara and allowing a magnification up to 15 times of objects in strong relief, by the successive focussing of different planes.—**Amé Pictet** and **Hans Vogel**: The synthesis of raffinose and that of sugar in general. Raffinose has been obtained synthetically by heating in a vacuum for an hour at 160° C. an equimolecular mixture of saccharose and galactose. The authors emphasise the fact that this synthesis is not the result of chance reactions. In the biological field it appeared to them that in the mammal at certain times a part of the glucose of the blood is transformed by the transposition of one of its hydroxyl groups into galactose, and that the latter unites with another portion of glucose to form milk sugar.—**F. Chodat** and **V. Pfister**: The bacteriological study of a vinegar factory. The following organisms have been found: *Bacterium xylinum*, inactive and objectionable, inactive Micrococci, active types of *B. acetosum* and *B. Schutzenbachii*; yeasts, *Wilbia anomala* producing the esters of the vinegar.—**E. Joukowsky**: The periodical variation of the proportion of materials in solution in the water of the Arve at Geneva. The author traces for the year 1890, from daily data, the curve showing the variation in the total solids in solution and suspension in the water of the Arve, and also the curve of average temperatures of that region. From these curves it is concluded that the chief source of dissolved chalk must be the water produced by melted snow (cold water with high solvent power) which is added to the water filtering in slowly, whilst the materials in suspension arise from running waters with rapid circulation.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 14-15).—**V. N. Ipatiev, N. A. Orlov**, and **A. D. Petrov**: The hydrogenation of ketones under pressure. Hydrogenation of the ketones under pressure leads easily to the formation of the respective aromatic carbohydrates, but fully hydrogenated products are obtained only with difficulty.—**A. Frank-Kamenetsky** and **V. Koncevič**: The Emykey saline spring on the Osinskij island on the Angara River. Analyses of water of the spring.—**V. V. Bogačev**: A new find of Mediterranean elements in the Caspian fauna. The mollusc *Mytilaster lineatus* known from the Black Sea was found in the Caspian, where it probably must be regarded as a post-Pliocene immigrant.—**A. I. Tolmačev**: A new arcto-alpine species of *Senecio*. Description of *Senecio tundricola*, sp. n., from Arctic Siberia.—**L. N. Bogojavlenskii**: A radium deposit at Uchta. Water from the oil-wells in the Uchta oil-fields proved to contain radium in a quantity exceeding that known from any other analogous sources. It is interesting that high concentration of radium and mesothorium coincides with complete absence of uranium and thorium.—**A. N. Pylkov**: Preparation of ionium from a Ferghana mineral. Certain preparations of ionium were obtained from the crude urano-copper-vanadium ore from the Ferghana mines.—**B. Zemliakov**: The ancient continental dunes of the Nizhni-Novgorod province. The dunes are studied in some detail, and it is concluded that they date back to one of the inter-glacial periods.—**D. S. Beliankin**: The problem of mullite. Mullite is a homogeneous solid solution of Al_2O_3 in sillimanite, according to some authors, but detailed studies of its properties show that mullite should be better regarded as quite independent from sillimanite.—**V. Bodylevskii**: Notes on the *Aucella* from the Taymyr collection of Middendorf.—**L. Ahrens**: The northern limit of distribution of the lizard *Eremias arguta* in eastern Europe. The species was discovered in the Kursk province, considerably farther north than before.—**A. I. Zaitseva**: Ferrous phosphate from the Bargusin region in Siberia. An analysis is given.—**E. F. Miram**: Description of the hitherto unknown male of *Metrioptera pusilla* Mir. (Orthoptera) from the Kherson province.—**E. Cheisin**: A preliminary communication on some parasitic infusoria of Lake Baikal. Descriptions of several new species.

ROME.

Royal National Academy of the Lincei, April 15.—**G. Cesàro**: Viviani's curve. The case of a spherical curve projected on to the base of a hemisphere following a circumference tangential to this base is considered, and it is shown that the surface intercepted by the curve on the sphere is expressed by the product of the square of the radius of the sphere, and the difference between the latitude of the culminating point of the spherical curve and the sine of such latitude. Thus, if $2S$ and ϕ are the surface and the latitude respectively, $S = R^2 (\phi - \sin \phi)$. The case of Viviani's window corresponds with $\phi = \pi/2$, so that $S = R^2 (\pi/2 - 1)$, and Viviani's curve represents the points of the sphere for which the longitude is equal to the latitude. The stereographic projection of Viviani's curve on the base of the hemisphere is a strophoid, and, if the term spherical strophoid is applied to a curve analogous to the plane strophoid, but constructed with a circumference of a great circle instead of with a straight line, Viviani's curve represents a spherical strophoid.—**G. A. Crocco**: The torsional rigidity of aeroplane wings.—**R. Calapso**: Reduction of the projective deformation of a surface R to the transformation C_m of isothermal surfaces.—**G. Vitali**: Covariant derivations in generalised absolute calculus.—**G. Vranceanu**: Periodic solutions to very large periods in mechanics.—**E. Gugino**: The problem of the elastic equilibrium of rotating bodies with cylindrical contour.—**A. J. McConnell**: The principle of stationary action and stability in a static gravitational field. On the basis of Levi-Civita's combination of the equations for the motion of a material point in a static gravitational field to a variational formula, which may be interpreted as a principle of stationary action, the stability of a trajectory in such a field is discussed.—**F. Sbrana**: The plane motions of an incompressible fluid, in which the stream lines are isotachic.—**C. Dei**: The phase of the thermionic saturation current in a circuit with pulsating voltage. The conditions in a circuit having in series a valve, an ohmic resistance, a coil of known coefficient of self-induction, and a pulsating electromotive force of the type $E = \bar{E} + E_0 \sin \omega t$, but sufficient for the valve to be always saturated, are considered.—**A. Rostagni**: An influence of X-rays on the crystallisation of bismuth. No appreciable alteration can be detected in the thermo-electric properties or the specific heat of bismuth as a result of exposure of the metal to the influence of X-rays.—**G. Carobbi**: Chemical investigations on the olivine of Linosa (Pelagic Islands). It is not certain whether the ferric iron, almost always found in olivines of volcanic origin, owes its presence to alteration, or whether it is pre-existent in the molecule as an isomorphous substituent of the ferrous iron and magnesium. If, however, all the iron found by the author's analyses is calculated as ferrous oxide,

and the sum of all the components is made up to one hundred (water being neglected), molecular ratios are obtained which are in absolute accordance with those required by the formula of olivine. The small proportions of lead present apparently replace isomorphically the magnesium and the other metals of its isomorphogenic group.—**F. Rodolico**: Investigations on sulpho-salts (5). Additive compounds with urotropine. Gradual replacement of the oxygen of the additive compounds, $MgMoO_4$, $C_6H_{12}N_4$, $10H_2O$, and $MgWO_4$, $C_6H_{12}N_4$. $10H_2O$, by sulphur is not accompanied by corresponding morphotropic variations in the crystals.—**G. Spagnol**: Chemical factors which determine the fixation of colloids. Experiments on dogs, rabbits, guinea-pigs, and moles show that, if chloroform is applied for a few seconds to the skin of an animal, and, almost at the same time, a colloidal substance is injected endovenously, the colloid becomes fixed in the tissues, corresponding exactly with the place of application of the chloroform. If the duration of the latter is 5–15 seconds, the fixation of the colloid takes place mainly in the cutis and the subcutaneous tissue, whereas with an application of 1–2 minutes, certain of the underlying muscles are affected. Histological examination shows that the colloid is, to a slight extent, fixed in the granular state on the walls of the blood vessels, but mainly diffuses in a highly disperse state into the surrounding tissue, and there soon passes in a granular condition between the phagocytes. This fixation is observed only with electro-negative colloids. Analogous results are obtained if carbon tetrachloride, ethyl bromide, or ether is used in place of the chloroform.—**A. Cavinato**: New investigations on the transformations of scolecite. The optical transformations occurring when scolecite is heated are related to the dehydration produced.—**R. Savelli**: Humification of cellular membranes in *Beta vulgaris*. Humification, which is normal and general for the fruit of all varieties of the beet, is shown also in the root in exceptional varieties, resulting possibly by mutation, and would hence depend on a new factor determining a new localisation of a phenomenon which pre-exists and forms a part of the normal physiology of the plant.—**G. Santori**: The influence of partial irradiation of the bone on the stromatic system of the osseous medulla and of the remaining hæmo-lymphatic apparatus. Localised action of X-rays on the tibial osseous medulla of the rabbit induces in the hæmo-lymphatic apparatus modifications which are greatest in the medulla directly exposed to the rays, but sensible also in the non-irradiated medulla and in the other organs of the apparatus. The alterations in the osseous medulla affect all its components—the specific cellular elements, and the stromatic apparatus; those in the spleen, lymph glands, and liver are mainly in the vasal and reticular components; appreciable alterations were observed in one case only in the thymus, and never in the suprarenals.—**E. Barsali**: Contribution to the study of radioscopy in vegetable organisms. Results are described which justify the hope that in the vegetable as well as in the animal kingdom radioscopy may prove of service, particularly in pathological cases.—**A. Galamini**: Alimentary value of the potato for albino rats. Raw potatoes, even if ingested in large quantity, do not form a sufficient food either for the growth or for the life of the albino rat. Boiled potatoes enhance the resistance towards contagious, broncho-pneumonic processes less than a complete diet. Growing rats die after losing 29-27 per cent of their weight, while with adults the diminution is 40 per cent; the loss is more rapid with raw than with cooked potatoes. When either of these is administered for a long time, alkaline urine, diarrhœa, stoppage of the bowels, and dilation of the ileo-cecal tract are observed.—**Constantino Gorini**: Progressive culture and microbic dissociation. In the natural dissociations of the acido-proteolytes, such as *Bacillus acidificans presamigenes casei*, the biochemical manifestations are accompanied by cultural morphological phenomena, which are characterised particularly by variations in the colonies, mainly into two principal types, and by variations in the aggregation and in the cellular mobility, which may be controlled by means of the author's progressive culture, so that the more active and mobile granular type may be selected. By the same means it is possible to detect, in a group of sporogenic bacilli, a transitory mobility restricted to initial stages of development, this giving rise to colonies of a type differing from the type characteristic of the respective species.

SYDNEY.

Royal Society of New South Wales, July 4.—**A. R. Penfold** and **F. R. Morrison**: The occurrence of a number of varieties of *Eucalyptus dives* as determined by chemical analysis of the essential oils (2). A field inspection was made in the Tumbarumba District of New South Wales in connexion with Variety 'C.' This field had been closed to commercial distillation for some time on account of the periodical occurrence of phellandrene, which spoilt an otherwise excellent oil for pharmaceutical purposes. Belts of country were resolved into 'good' and 'bad' by simply crushing the leaves between the fingers and judging according to the odours evolved. The examination of the essential oils from representative samples of leaves and terminal branchlets confirmed in a remarkable manner the field observations. Opportunity was taken to test out the new cresol method for determination of cineol in these oils. It was found necessary, however, to make the determination on the portion of oil distilling below 190° as the presence of terpineol in the hard boiling fraction gave high results. The method is strongly recommended as a standard one.—**R. J. Noble**: Some observations on the woodiness or bullet disease of passion fruit. The disease may be recognised in the stunting of the vines, in twisting, curling, or mottling of the foliage, and in the hard malformed fruits of *Passiflora edulis*. The hardening of the fruits is due to lignification of the inner parenchymatous tissues of the pericarp. The disease occurs generally in the winter months, but is considered one of the major causes of unproductiveness of passion fruit vines in N.S.W. Infection experiments have demonstrated that the disease is due to the action of a virus which may be transferred by mechanical means. Control measures are recommended.

Official Publications Received.

BRITISH.

Melbourne Astrographic Catalogue, 1900·0. Vol. 2: *Zones* −67° and −68°. Rectangular Co-ordinates and Diameters of Star Images, from Photographs taken and measured under the direction of R. L. J. Ellery and Pietro Baracchi. Revised and prepared for publication under the Supervision of Dr. J. M. Baldwin. Pp. xi+291. (Melbourne: H. J. Green.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 380, August. Pp. 805-908+xxx. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Reports of the Imperial Economic Committee. Tenth Report: Timber. (Cmd. 3175.) Pp. 52. (London: H.M. Stationery Office.) 9*d*. net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1137 (Ae. 307): Tests of a Metal Airscrew in a Closed Tunnel for Comparison with American Tests in an Open Jet Tunnel. By H. C. H. Townend and J. H. Warsap. (T. 2548.) Pp. 4+8 plates. 6*d*. net. No. 1139 (Ae. 308): The Connection between Lift and Circulation for an Inclined Flat Plate. By A. Fage and F. C. Johansen. (T. 2558.) Pp. 7+1 plate. 6*d*. net. (London: H.M. Stationery Office.)

Western Australia: Geological Survey. Bulletin No. 88: Maps and Sections compiled by H. W. B. Talbot, to accompany his Report on The Geology and Mineral Resources of the North-West, Central and Eastern Divisions between Long. 119° and 122° E. and Lat. 22° and 28° South. Pp. ii+15 plates. (Perth: Fred. Wm. Simpson.)

FOREIGN.

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 31: Climatological Data for Northern and Western Tropical South America. By W. W. Reed. (W. B. No. 952.) Pp. iii+21. (Washington, D.C.: Government Printing Office.) 10 cents.

University of Colorado Bulletin. Vol. 28, No. 10, General Series No. 259: Catalogue, 1927–28; with Announcements for 1928–29. Pp. 521. (Boulder, Colo.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. On a Collection of Birds from the Pará Region, Eastern Brazil. By Witmer Stone. (With Field Notes by James Bond and Rudolph M. de Schauensee.) Pp. 149-176. Species of Polygyra from Montana, Idaho, and the Pacific Coast States. By Henry A. Pilsbry. Pp. 177-186. On the Relationship of certain New or Previously known Genera of the Acridine Group Chrysochraontes (Orthoptera, Acrididæ). By James A. G. Rehn. Pp. 189-205. (Philadelphia, Pa.)

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 1, July. Pp. 104. (Washington, D.C.: Government Printing Office.) 25 cents.

International Union of Scientific Radio Telegraphy. Papers of the General Assembly held in Washington in October 1927. Vol. 1: Scientific Papers presented in the Public Session. (Original Texts.) Pp. 78+4 plates. (Bruxelles.)

CATALOGUES.

A List of X-ray Tubes, including Gas and Hot Cathode Types. Pp. 82. (London: Cuthbert Andrews.)

Light on the H.T. Battery. Pp. 24. (London: Ripaults, Ltd.)

Diary of Societies.

FRIDAY, SEPTEMBER 14.

CERAMIC SOCIETY (Refractory Materials Section) (at Royal Technical College, Glasgow), at 10 A.M.—C. Edwards: Jointing Cement.—W. J. Rees: A Comparison of the Properties and Industrial Durability of Lime-bonded and Clay-bonded Silica Bricks.—W. J. Rees and D. W. Hubbard: The Dissociation of Carbon Monoxide in Contact with Fireclays and Silica.—C. E. Moore: Drying Cracks.—A. J. Dale: Aluminous Refractories and their Industrial Significance.

SATURDAY, SEPTEMBER 15.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Town Hall, Swanage), at 11.30.

PUBLIC LECTURES.

WEDNESDAY, SEPTEMBER 19.

CHARACTER BUILDERS' ASSOCIATION (45 Lancaster Gate, W.2), at 8.—T. Cooke: Temperament in Relation to the Endocrine Glands.

FRIDAY, SEPTEMBER 21.

CHARACTER BUILDERS' ASSOCIATION (45 Lancaster Gate, W.2), at 8.—T. Cooke: The Analysis of Temperament.

CONGRESSES.

SEPTEMBER 14–17.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Fifth Annual Conference) (at New College, Oxford).

Friday, Sept. 14.

At 7.15 P.M.—
Address by the President of the Conference.

At 8.30-9 P.M.—
Dr. R. S. Hutton: The Work of Aslib.

At 9-10 P.M.—
Dr. A. P. Thurston: Patent Law Reform, with Special Reference to the Search for Novelty.

Saturday, Sept. 15.

At 9.30-12 NOON.—
N. Parley: The Direct Reproduction of Books and Manuscripts.
Dr. E. H. Tripp: Certain Aspects of Agricultural Research.
J. Forbes Marsden: The Literature of Scientific Management.

At 12-12.45 P.M.—
H. H. Johnson: Existing Types of Indexes to Technical Periodicals.
V. Garrett: An Index to Business Data.
J. N. L. Baker: Cartography and the Research Worker.

At 5.30-6.30 P.M.—
Annual General Meeting.

At 8.30-10 P.M.—
H. Jenkinson: The Librarian as Archivist.
F. M. Earle: Vocational Selection and Guidance.
A. Esdaile: Unification of the Library Resources of London.

Sunday, Sept. 16.

At 9.30-11.45 A.M.—
Dr. W. Rosenhain: Scientific Abstracts.

At 11.45-12.45 P.M.—
A. Farquharson: Civic and Regional Surveys: their Relation to Information Bureaux.

At 5-6 P.M.—
C. R. Griffin: A Book-Review Digest.
Capt. J. S. Allan and N. Parley: The Durability of Paper.
Lieut.-Col. J. A. A. Pickard and C. G. Ingall: Information on Accident Prevention.

At 8.30-9.15 P.M.—
Dr. S. C. Bradford: The Necessity for the Standardisation of Bibliographical Methods.

At 9.15-10 P.M.—
Lieut.-Col. J. M. Mitchell: The Aslib Directory.

SEPTEMBER 15–22.

GERMAN SOCIETY OF NATURALISTS AND PHYSICIANS (at Hamburg). Among the lectures are: World Economics and National Food Supply, F. H. Witthoefft; The Importance of Wöhler's Synthesis of Urea, Prof. Walden. The Blood Group Problem, Photochemistry of Iron Carbonyl Compounds, Combating Cattle Plagues, Naegeli's Micellar Theory, and the Importance of Isostasy in the Shaping of the Earth's Surface, Scientific Results of the Voyage of the *Meteor*, Short-wave Telegraphy, Chemistry of Hormones and the Female Sexual Hormone. In the medical group the Onset and Disappearance of Epidemics and the Influence of Psychic Factors on the Sympathetic Nervous System will be dealt with. Popular evening lectures will deal with the Ultramicroscopy of the Molecule by the use of Rontgen Rays, the World and Environment, Health and Housekeeping, Colour and Scent of Flowers, Communities of Men and Bees.

SEPTEMBER 19–22.

NATIONAL GLASS CONVENTION (at Bournemouth).—Discussions on the Organisation of the Glass Industry and a Conference on the Legislation Concerned.

SEPTEMBER 19–25.

FOLK-LORE SOCIETY JUBILEE CONGRESS, 1928 (mainly at Society of Antiquaries).

Wednesday, Sept. 19.

At 4 P.M.—
Opening Session.

At 8.30 P.M.—
Reception at the Wellcome Historical Medical Museum, 54A Wigmore Street, W.

Thursday, Sept. 20.

At 10 A.M.—
Sir Richard Temple, Bart.: Presidential Address.
Mrs. Banks: Some Traditions of Stone-carrying Women.
T. W. Thompson: British Gypsy Marriage and Divorce Rites.
Prof. F. Starr: Filipino Folk-lore.
Rev. Prof. A. H. Sayce: Egyptian Folk-lore.

At 8.30 P.M.—
(At Imperial Institute.) Prof. Pospisil: The Folk-dances and Customs of Central and Eastern Europe (Lecture).

Friday, Sept. 21.

At 10 A.M. and 2.30 P.M.—
Prof. H. J. Rose: Mummers' Plays in Attica.
Prof. R. M. Dawkins: The Study of Folk-lore in Modern Greece.
Mrs. Hasluck: A New Dervish Order in Albania.
Prof. Gwynne Jones: Some Survivals of Folk-belief in Modern Wales.
M. Beza: Demetrius Contemir's Contribution to Folk-lore.
Mrs. H. H. Spoer: Hebrew Amulets.

Saturday, Sept. 22.

Excursions to Oxford and Cambridge.

Monday, Sept. 24.

At 10 A.M. and 2.30 P.M.—
Prof. Pettazzoni: Confession of Sins in Primitive Religions.
Dr. J. L. Myres: Paper.
Miss B. C. Spooner: The Fragments that are Left in N.E. Cornwall.
Dr. MacCulloch: The Arthurian Legend.
Miss Mona Douglas: Animals in Manx Folk-lore and Song.
R. E. Enthoven: Tree and Animal Worship in Western India.

At 8.30 P.M.—
(At Caxton Hall.) Demonstration of Folk-dances; Children's Singing-games; Folk-songs.

Tuesday, Sept. 25.

At 10 A.M. and 2.30 P.M.—
Prof. Elliot Smith: The Survival in English Folk-lore of a Story from the Rig-Veda.
Dr. E. Jones: Psycho-analysis and Folk-lore.
Dr. Róheim: Mother Earth and the Children of the Sun.
H. Simpson: Medical Magic among the Berbers of Algeria.
Prof. G. Schütte: Bull Worship among the Kimbri.

SEPTEMBER 24–27.

INTERNATIONALE TAGUNG FÜR BRÜCKEN- UND HOCHBAU (at Vienna).

SEPTEMBER 24–27.

INTERNATIONALE TUBERKULOSEKONFERENZ (at Rome).

SEPTEMBER 24–28.

DIE TAGUNG DER BALTISCHEN GEODÄTISCHEN KOMMISSION (at Berlin).

SEPTEMBER 26–29.

PALÄONTOLOGISCHE GESELLSCHAFT (at Budapest).

SATURDAY, SEPTEMBER 22, 1928.

CONTENTS.

The Revolution in Physics.

ON April 19 last, Sir Oliver Lodge gave the nineteenth Kelvin lecture to the Institution of Electrical Engineers.[1] When he gave the fifth Kelvin lecture in 1914, he chose as his subject the electricity of the atmosphere—both natural and artificial. This year he took as his subject the revolution in physics and expounded it in his inimitable way. He controverted the statement so confidently made a few years ago that the effect of the revolution has been to abolish the ether of space. He considers that not only has the existence of the ether been established, but also that a rational theory of it has already begun. He points out what a tremendous discovery it would be if the universe could be proved to be finite. Possibly the finiteness of space only means that it is our particular cosmos that is finite. We cannot say what is beyond it ; there is no means of getting at what is beyond it. Still, absolute units have been discovered, that is, discontinuous things which can be counted ; for example, the electron and the quantum. Many years ago the discontinuity of matter was observed. Now the atom itself has been resolved into electric charges which are localised portions of energy embedded in the ether. It is a great discovery that matter is a form of energy.

There is a great conflict, beginning in ancient times and continuing ever since, between continuity and discontinuity. Every discontinuity discovered is a step in advance. But there is little doubt that continuity will conquer in the end. Twenty or thirty years ago it seemed that a great deal was known about the electron. Its size, mass, and so on could be computed. Some of this knowledge still remains valid, but the twentieth century has put everything back into the melting pot. We are ignorant of the nature and constitution of the electron, and we are now uncertain as to its size and speed. The mathematical methods now employed are of a novel and almost of an experimental kind. Mechanical theories of the ether have had to be abandoned. This is what is meant, or should be meant, by the statement that the ether no longer exists.

Electrons are what electrical engineers specially deal with. We have had these active little creatures harnessed for a good time, and have propelled many things by their aid, from telegraph messages to railway trains. But we have never been allowed to see them even metaphorically. They are

[1] *Jour. Inst. Elec. Eng.*, vol. 66, p. 1005 ; 1928.

cloaked, so that we are like a costermonger with a shrouded animal between the shafts; it may be a dog, a zebra, or a donkey. We can only infer its nature from its more or less tractable behaviour. Electrons have proved themselves very obedient to the smallest guidance, and very energetic.

The only semi-dynamical theory of the ether which seems likely to survive is the perfect incompressible fluid in vortex motion, the fine-grained rotational structure worked at by Kelvin and FitzGerald. A fluid in vortex motion is able to transmit transverse waves, for vortices have many of the peculiar properties of a gyrostat. Difficulties arose about stability. Nowadays, however, a doubt about stability is not fatal, since something unexpected like the quantum may turn up to stabilise matters. Bohr's orbits, for example, were not stable until the quantum arrived. Even now no one can fully explain the quantum, though admittedly it has stabilising qualities, since it emphasises whole units and declines to admit fractions. It refuses continuous emission, it favours jumps rather than slides, and prefers staircases to slopes. Jeans has said that if it were not for the quantum, matter would very quickly radiate itself away into space. The only reason why everything does not go off in a flash is because of the quantum. It has rendered matter permanent.

Modern physics aims at simplifying the complex by the aid of relativity and quanta, but it has raised difficulties where previously we detected none, and has made simple things complex. A beam of light seems a simple thing, but now the structure of light has become puzzling and has acquired some of the properties of matter. Reciprocally, matter has acquired some of the properties of light. The particle and the wave are more closely related than a few years ago we should have thought it possible to imagine. The quantum theory made waves behave something like particles; conversely, the new dynamics makes particles behave something like waves. Planck has said that in many of our theories we must build up again from the very beginning. In the nineteenth century everything was reduced to mechanics; now the very motion of matter itself is in need of explanation.

One difficulty in verifying experimentally theories in connexion with corpuscles and waves is that we cannot make direct experiments on the ether. We have no means of examining radiation in free space; we can only deal with it when it interacts with matter. Nevertheless, some experimental confirmation of the existence of a wave structure as part of a flying electron has recently been made by Prof. G. P. Thomson, of the University of Aberdeen. He sends cathode rays through a metal film of molecular thickness. He gets on the examination plate not a point, but a point with rings round it. He gets a diffraction pattern, and this must mean waves. The experiment is a verification of the theory which associates wave motion with rapid particles and enables us to calculate the wavelength from the potential drop which propelled the particles. Magnetic force deflects the waves, wiping out most of the pattern from its original place and putting it round the deflected spot. This is a very important discovery. The important difference between these rays with nuclei in them and ordinary X-rays must not be forgotten. One variety is affected by a magnetic field and the other is not. Matter is one extreme and light is the other. Here we recognise an intermediate thing which establishes the reality of light quanta.

Sir Oliver made a suggestion of the possible structure of an electron. He imagines it to be a minute bubble or minute cavity in the continuous structure of the ether. To produce such a hollow against the enormous pressure must involve the expenditure of a great amount of energy. Lines of strain permeate the ether in all directions from the hollow. These constitute the electrostatic field. The energy resides not only in the hollow but also in the inseparable electrostatic field. If we call c the 'constitutional' velocity of the ether, its pressure will be ρc^2 where ρ is the density. This is an enormous pressure, but when we consider that the ether has to transmit gravity and all the other forces we apply to it, the magnitude of its properties must vastly exceed those of the substances we are familiar with. The hollow sustains itself because of its electric charge. The electric charge produces a tension tending to make it expand. This is balanced by the external pressure. Calculations are given to show that the radius of the hollow computed in this way is of the same order as the recognised electronic charge.

Recent recondite speculations in mathematics and physics were barely touched upon. These theories are so striking that some of us who saw their beginning in the nineteenth century can scarcely follow their developments, let alone their eccentricities. The mathematical speculators are doing more than going out of our depth; they are soaring up into the clouds of tensors and matrices, with any number of dimensions of space and imaginary operators. In the old days, explorers used balloons, and we might

occasionally swarm up the rope or haul them back to earth. Now they have no earth attachment and have quite gone out of sight. We can only follow their progress when they drop a bomb. Then we sit up and attend. But the bombs, although perturbing, are not destructive; when they are opened they are found to contain interesting things, more like seeds than explosives, and those which take root flourish exceedingly and overshadow the ancient fields. The older method was to plant a seed quietly in the ground so that we could watch it grow. Radioactivity was one, the electron was another, and so also was Bohr's theory. We must now recognise that wave mechanics is the beginning of one branch of a theory of the ether, which must be contemplated by every physicist who is interested in physical reality.

Continental Drift.

Theory of Continental Drift: a Symposium on the Origin and Movement of Land Masses, both Inter-Continental and Intra-Continental, as proposed by Alfred Wegener. By W. A. J. M. van Waterschoot van der Gracht, Bailey Willis, Rollin T Chamberlin, John Joly, G. A. F. Molengraaff, J. W. Gregory, Alfred Wegener, Charles Schuchert, Chester R. Longwell, Frank Bursley Taylor, William Bowie, David White, Joseph T Singewald, Jr., and Edward W. Berry. (Published under a Fund established by the New York Committee for the Mid-Year Meeting of the Association, November 1926.) Pp. x + 240. (Tulsa, Oklahoma: The American Association of Petroleum Geologists; London: Thomas Murby and Co., 1928.) 15*s*. net.

THE complex problem of continental drift has everywhere been the subject of animated iscussion in geological circles during recent years, id the publication of the papers presented at a mposium held in New York late in 1926 serves valuable purpose in bringing together the condered opinions of some of the leading geologists of merica and Europe. The American Association Petroleum Geologists is to be congratulated not ly on having staged a spirited and fruitful dission, but also on its enterprise in making the ntributions available in printed form to a worldde audience. The book opens with a broadnded and constructive review of the problem by . van der Gracht; this is followed by papers from irteen other authors, for the most part severely tical; and finally, Dr. van der Gracht summarises various arguments brought forward, and restores the balance by showing that many of the objections raised need not stand unanswered.

There is a general agreement that Wegener's methods in advocating his particular group of hypotheses are to be condemned. His plausible selection of data, frequently erroneous age determinations, faulty analysis of causes and devious reasoning, have undoubtedly had the effect of weakening his case. There is, indeed, a distinct danger that the easy disproof of large sections of the Wegener hypotheses may be mistaken for a demonstration of the impossibility of continental drift as a geological process. The important issue is now not so much to prove Wegener wrong as to decide whether or not continental drift has occurred, and if so, how and when.

Schuchert, Longwell, and White wonder what forces can have conspired to hold the sial together in one great land-mass—Pangæa—until Mesozoic time, when the alleged fracturing and drifting apart began. There is, of course, neither proof nor probability that there ever was a single 'Pangæa,' and it is reasonably suggested by van der Gracht that there may have been a pre-Carboniferous 'Atlantic' which was closed up by the Caledonian diastrophism. He is careful, however, to commend Wegener for not leading us into a discussion of remote periods, regarding the palæogeography of which our evidence is still lamentably meagre.

Several authors are concerned to prove that the opposing shore lines of the Atlantic do not fit so closely as Wegener supposes. Van der Gracht rightly lays no stress on the validity of geographical pattern as an argument, for surely if drift has occurred it is mechanically impossible that the sial blocks should have moved without internal and peripheral distortion. Argand's conception of varying plasticity is a valuable corrective to the exactly fitting coast lines of Wegener's too dogmatic maps. Schuchert presents a valuable summary of the geological similarities and differences between the opposing Atlantic lands. He admits that Wegener is correct in connecting the Caledonian trends of Britain with those of Newfoundland, but denies that the Hercynian trends of Europe connect with the Appalachians. Against this we may refer to Mr. E. B. Bailey's statement of the comparison in NATURE of Nov. 5, 1927. Mr. Bailey is by no means one of Wegener's sponsors, yet he says, "It is as if the Atlantic did not exist or, in other words, as if Wegener, after all, were a true prophet." Attention should also be directed to the recent discovery of Caledonian overthrusts along the east coast of Greenland, apparently representing

structures that are missing from Norway. Similarly, against adverse criticisms such as those of Krenkel, based on a comparison of western Africa and eastern South America, we can set the recent work of du Toit (*Pub*. No. 381, Carn. Inst. Washington; 1927). Although actual contiguity of the opposed shores can definitely be ruled out, the geological parallels are too significant and intimate to be brushed aside or explained by long narrow land-bridges. Schuchert is undoubtedly right, however, in regarding the supposed separation of Newfoundland and Ireland so recently as the Pleistocene as out of the question.

Molengraaff and Taylor both regard the mid-Atlantic swell as the cicatrix of the main fracture which led to the separation of America and Eur-Africa, and van der Gracht is inclined to agree. A relative movement of the African mass to the east would possibly explain the pre-Gosau Oman arc, which, as Lee has pointed out (*Geog. Journal*, May 1928) is inconsistent with Wegener's scheme. Wegener has certainly insisted too strongly on the dominance of westerly drift, and both he and van der Gracht are probably wrong in regarding the island festoons of Asia as a consequence of such drift.

Taylor's contribution to this problem, in which he draws an apt analogy between continental ice-sheets and continental sial-blocks, is worthy of serious attention. Like du Toit, he regards the lands of the northern hemisphere as being surrounded by a nearly closed orogenic ring; he describes the arcuate ranges as marking the terminal regions of "currents in the crust." Extending the conception to both hemispheres, he writes: "The crustal movements were radial and dispersive from both polar regions, and tended to culminate in a piling up of mountain ranges and plateaus in low latitudes." Taylor probably goes astray when he suggests that the "crust-moving force was of external origin." He thinks that tidal forces would be adequate to explain the phenomena if the moon had been captured during the Cretaceous period. Unfortunately, even if this extravagant claim could be justified, we should still be without an explanation for the Hercynian, Caledonian, and older systems of folded mountains.

This introduces the vexed question of the forces available to 'engineer' the drifting process. Longwell clearly presents the geophysical position, which at present is distinctly unfavourable to the possibility of drift. He points out that a force adequate to overcome the strength of the sima is required, and that it is extremely improbable (most of us would less cautiously say 'impossible') that sima can yield like water before a floating raft. Bailey Willis raises the objection that the sial must be weaker than the sima if the mountains of western America are a result of pressure encountered by the moving sial, and Bowie points out, conversely, that if the sima has no strength, as postulated by Wegener, the continental front could not meet a sufficient resistance to crumple it up into mountains. The reply here is surely that both sima and sial would fracture or crumple according to their strengths and viscosities, but that the crumpling of the sial would alone appear at the visible surface. Singewald reminds us that no one can say whether the ocean floor is folded or not, and van der Gracht adds that a mountainous form, if ever developed, could not be preserved in sima. My own view, assuming the movement, is that the overthrust, folded and metamorphosed sima would be pressed down or would sink into the substratum, so making way for the continents to advance.

Joly's fluid substratum would facilitate slipping between the crust and the interior, but the postulated tidal drift would be likely to affect the whole crust. Joly himself makes three important points: that differential forces would act on the continents while they were in flotation; that disintegrating forces would arise during the expansion and contraction accompanying each revolution; and that the necessity for thermal escape would possibly prevent the permanent existence of an aggregate of continents such as 'Pangæa.' Nevertheless, it is widely recognised that while acceptance of Joly's hypothesis would help to ease the problem of the mechanism of drift, the hypothesis fails to lead to the required consequences, and has, moreover, special difficulties of its own to overcome.

Gregory does not positively object to the drift hypothesis, but he maintains his well-known opinion that movements of uplift and subsidence due to the shrinking of the earth (not necessarily by cooling only) are to be regarded as the main causes of the present distribution of land and water. It is perhaps not sufficiently realised that those who hold this, the orthodox view of the older geologists, including the exponents of land-bridges, have to face geophysical difficulties quite as serious as any with which they can confront the advocates of lateral displacement. The accepted phenomena of isostasy stand in flat contradiction to the subsidence of land to oceanic depths. If there is ocean where once there was land, then the former sial of that area must now exist somewhere else.

The only alternative to lateral drift is removal of the sial at the base by magmatic currents in the substratum, but if this be a possible method of sinking land-bridges, then it implies a process capable of transporting continents. Van der Gracht hints at this when he asks, "Is not possibly the whole process more similar to ice floating on flowing water (Ampferer's 'undercurrents') than a raft sailing over a currentless pool?" Geophysics will not be in a position to deny continental drift until it has thoroughly explored the possibilities of convection or other currents in a highly viscous substratum, and the forces set up by the interaction of magnetic and electric fields. Apart from van der Gracht's suggestion of "a plastic outflow of the interior continental masses toward their margins" and a vague reference by Taylor to "magnetic force," these possibilities appear to have been entirely overlooked in favour of quite inadequate gravitational forces.

In the absence of any clear geophysical lead, the geologist must choose either lateral or vertical displacement of former land-masses (unless he wants both) on their merits in relation to other problems. Schuchert, though iconoclastic towards the Wegener hypothesis, feels "obliged to conclude that the continents do actually move extensively" in order to explain the crustal shortening implied by mountain structures. Termier, who describes the Wegener hypothesis as "the dream of a great poet," does not hesitate to regard the mountains of Central Asia as representing a crustal foreshortening of the order of 1800 miles. Van der Gracht naturally points out that if this be admitted, then continental drift even on the Wegener scale becomes fully possible.

The opponents of drift have also no way of explaining the distribution of the Permo-Carboniferous glaciations of Gondwanaland, which accordingly remains the basis of Wegener's most powerful argument. Wegener himself discusses the Squantum 'tillites.' If these are truly glacial, they stand in flagrant contradiction to his views, since they occur near his Permo-Carboniferous tropical belt. He pleads for an independent and impartial decision of the problem, but he adds with complete justification that the glacial hypothesis of these puzzling beds is also hopelessly in conflict with the adjoining palæoclimatic evidence of the time. Neither the drift nor any other theory can be reasonably expected to explain interpretations that are mutually contradictory. No one in the symposium pointed out that the distribution of Carboniferous laterites and bauxites adds further support to Wegener's reconstruction of the climatic belts then existing.

The impression that remains with me after considering all the adverse criticism is that the latter is mainly directed against Wegener, and that when all has been said, there remains a far stronger case for continental drift than either Taylor or Wegener has yet put forward. At least two kinds of movement seem to be required: a general drift of the crust as a whole with a northerly component (removing the neighbourhood of Natal from the South Pole since the end of the Carboniferous); and radial movements, outwards from Africa in the southern hemisphere, and outwards from Eurasia in the northern hemisphere (in each case towards the Pacific and the Tethys), giving rise to peripheral mountains and interior disruption basins. But so vast a subject is not one for 'resounding convictions.' As van der Gracht insists again and again, the details of the picture, and particularly the mechanical and physical explanation, will require generations of further research.

ARTHUR HOLMES.

Palæolithic Times in Italy.

Archives de l'Institut de Paléontologie humaine. Mémoire 3: *Le paléolithique italien.* Par Raymond Vaufrey. Pp. 196 + 7 planches. (Paris: Masson et Cie, 1928.) n.p.

THE prehistory of the Italian peninsula has, for some reason or another, remained very obscure, and any information upon it has been difficult to obtain. It is true, of course, that the magnificent researches of the Grimaldi caves, published in the Prince of Monaco's series, threw a flood of light on the early story of that district, and some scattered information on palæolithic finds appeared as a sort of introduction to T. E. Peet's volume on the "Stone and Bronze Ages in Italy." But as the author of the work under review says, it was really not until Dr. Mochi threw himself into the study of these early problems that investigations on modern lines were initiated.

M. Raymond Vaufrey's book is exactly what has been long wanted—a clear, concise, and logical account of all that is at present known about palæolithic times in the Italian peninsula and in Sicily. Not least in importance is a reasonably large map showing the distribution of Lower Palæolithic, Mousterian, Upper Palæolithic, and Campignian sites. There is also an excellent and comprehensive bibliography to which reference is made throughout the text. The volume is illustrated

with a large number of line drawings figuring the industries from a good many sites, and there are seven full-page plates at the end. Personally, I should have preferred a larger proportion of these to have been devoted to typical views of the country and of well-known sites—there is only one. Implements are better illustrated by pen and ink drawings, and one or two plates of tools to act as a check on the draughtsman's skill would have been ample. A view of the important cave of Romanelli, with perhaps a reproduction of the Aurignacian wall-engraver's art found there, about which too little is said, would have been a valuable addition. However, it is clearly impossible in a work of some 200 pages to include everything, and we can only be very grateful to M. Vaufrey for giving us such an excellent account of Italy's palæolithic past.

After a short introduction, a brief account is given of the various investigations that have been undertaken since 1850. At first a considerable amount of work was done, but, in gentler and more polite language, Pigorini, the former Director of the Prehistoric Museum at Rome, is described as having acted as a blight on all palæolithic research. Doubtless it is a fact, and I do remember going to Rome many years ago and finding industries arranged in show-cases without their associated fauna, the remains of which were shot without order or labels into an attic! Such things did not interest Pigorini, I suppose. Still, I hope that those who come after us will not have to denounce too many things which we do quite happily to-day. It is undoubtedly true that since Pigorini has died and Mochi has been interested in palæolithic studies, our knowledge of Old Stone Age Italy has increased by leaps and bounds.

First the problem of the Lower Palæolithic culture in Italy is attacked. Only two localities yielding a definite stratigraphy—the one at Capri and the other near Venosa—are known, though finds referable to a Lower Palæolithic culture on typological grounds occur elsewhere. Scarcely any Lower Palæolithic finds, however, have been made in Sicily, and it is suggested that the Lower Palæolithic folk could not, therefore, have entered the peninsula from the south. All the same, a glance at the distribution map will show that there is but little indication of any definite migration from the north-east, and Lower Palæolithic tools—except for one or two examples from a cave at Monaco—are conspicuous by their absence along the Riviera. The author, I fancy, is a follower of M. Boule, so far as questions of chronology are concerned, and he assigns the Acheulean industries to the last interglacial period. But whether in Italy this corresponds to Penck's *Riss-Würm* in the Alps is not discussed, though it seems to be assumed.

The Mousterian culture is next described, and here the information M. Vaufrey is able to give us seems to me to be of particular interest. There seem to be two distinct industries—perhaps indeed cultures—probably more or less contemporary (?); one appears to belong to the true Mousterian of France, the other to the Levallois phase. This latter is becoming increasingly important and is being found in many of the older gravels in England. What its exact relationship to the Mousterian culture on one hand and to the Acheulean culture on the other is, is not yet known.

There follows a chapter devoted to the Upper Palæolithic sites in Italy which is particularly interesting in bringing together in a convenient form all that, up to the present, has been determined in this connexion. Finally, chapters on the palæolithic finds in Sicily, and the Campignian sites in the peninsula, conclude the volume.

The first two volumes in this series have already set a very high standard. Prehistorians will not find that this volume has in any way lowered it. It is indeed a very useful and important contribution to learning.

M. C. BURKITT.

Forest Utilisation in the U.S.A.

Forest Products, their Manufacture and Use. Embracing the Principal Commercial Features in the Production, Manufacture, and Utilisation of the most important Forest Products other than Lumber, in the United States. By Prof. Nelson Courtlandt Brown. Pp. xvii + 447. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 20*s*. net.

WHEN issuing the first edition of this book in 1919, Prof. Brown had as his object to present to the student and reader the chief commercial features involved in the manufacture and use of the principal forest products in the United States, other than lumber (that is, timber logged or squared to be used in cabinet and furniture work, shipbuilding, wagons, etc.), and to record something useful for reference purposes. The second edition brings the work up-to-date, including the intermediate development, and generally revises the U.S.A. statistics and prices.

The scope is a large one, and the author, within the limits of the book, has achieved the major part of what he set out to do. The forest products

dealt with are wood-pulp and paper, tanning materials, veneers and plywood-cooperage, naval stores (rosin and turps), wood distillation, charcoal, box and box-shooks making, sleepers, poles and posts, shingles, maple sugar, and a few others.

Each is described comprehensively, generally under the sequence of history, requirement, methods of extraction and manufacture (giving details of machinery and plant), the kinds of timber used, and the annual consumption; concluding with notes on the utilisation of waste and the grading rules in force. The whole is supported by useful statistical and costing figures, appropriate illustrations, as well as by the common American and botanical names of the timbers mentioned in the text, and the factors for conversion to European volumes and units.

To give some idea of the manner in which the subjects are presented, the details on cooperage may be further considered. For this the annual timber consumption is said to be 300 million cubic feet of timber, producing 800-1000 million staves, with the appropriate number of headings and hoops. There are two classes, slack and tight, the former including barrels, etc., for non-liquids and the latter for liquids. The variety of these is large, and each class in its turn is quality graded according to the prospective contents. For example, tongued and grooved staves are required for sugar and flour barrels, and the roughest of manufacture for those for vegetables: whereas for the valuable liquors, the best timber, with most careful adjustments, is necessary.

For this class of work the qualities required in the timber used are strength, straight grain, even texture, seasoning well; and for liquids, non-porous. In the best quality tight cooperage staves, only American White oak, *Q. alba*, and to a less extent *Q. minor*, *Q. acuminata*, *Q. macrocarpa*, and *Q. platanoides*, are used, inferior qualities being made of White oak, Red oak, *Q. borealis*; Red gum, *Liquidamber styraciflua*; Douglas fir, *pseudotsuga Douglasii*; Birch, *B. leuta*; and Hard maple, *A. saccharum*: for the headings, White oak is again the best, but Red oak, Douglas fir, Red gum, White ash, *F. americana*, Hemlock, *Tsuga spp.*, and Pine find a place, and for hoops, iron and steel have been substituted for wood. For the slack class, according to importance, similar woods are used for staves; Red gum is at present the most in demand, with almost any other kinds adaptable: for headings, Red gum and Pine, *P. palustris*, *P. echinata*, *P. taeda*, *P. resinosa*, *P. strobus* supply the bulk; and for the hoops, Elm, *Ulmus racemosa* and *U. americana* (at one time the leading slack stave woods) make the best, with hickory and ash, these being tough, with high tensile strength.

In the manufacture in slack cooperage, the logs and raw material are usually hauled to a central mill for conversion, but for the other class small plants are moved from place to place in the woods. In both cases selected trees are logged to size, split into small, convenient-sized blocks, and transported to the mill, where they are steamed, or boiled, and sawn by specially designed machines into staves and headings of the kind and qualities required. A very small proportion are now cleaved. The pieces are then air-dried, machine-shaped to size, bilge, and bevel; graded, and finally bundled for removal to the assembling works. In the description Prof. Brown goes into full detail, describing the machines, the various operations with their difficulties, giving the number of men employed in the operation with their piece-work costs, and winds up with the specifications and grading rules.

Space does not allow of further details here, but each product is similarly dealt with, giving, as has been mentioned before, a comprehensive description of the industry.

In Chap. i., under 'General,' the author alludes to waste in conversion, which is most important to forest officers. The volumes utilised are so enormous as to cause one to wonder what the condition of the forest is to allow such exploitation with due regard to the future. The rapid development of utilisation in America has overshadowed forestry, with the result that those concerned with sustained yields must be anxious if the figures are anywhere near correct. They seem to give an incidence of 40 cubic feet per acre per annum on the present gross forest area of 545 million acres, though it is not mentioned if this area is permanently and legally set aside to provide the raw material. To this incidence has to be added some 15-20 per cent, said to be lost by wastage in the forest in the felling and logging. Further, the author states that America is using its forests three times as fast as they grow. The United States, of course, is quite able to look after itself, but if the above is a criterion of the present position in that country (and Prof. Brown is an authority on the subject), the Colonial authorities of the British Empire have cause to take care that a similar condition is not repeated where they are custodians.

Finally, the treatment of his subject discloses the author's close connexion with the industries he describes, and the book can be recommended to all who are interested in the subject discussed.

Our Bookshelf.

University of Wisconsin Studies in Science. No. 4: *The Optic and Microscopic Characters of Artificial Minerals.* By Prof. A. N. Winchell. With Determinative Tables for Identifying Artificial Minerals Microscopically, chiefly by means of their Optic Properties. Pp. xv + 215. (Madison, Wis.: University of Wisconsin, 1927.) 1.50 dollars.

THIS new production of Prof. A. N. Winchell is, we believe, unique, at any rate so far as the English language is concerned. It is a compilation of data collected by the author during the preparation of the second edition of the descriptive part of his "Optical Mineralogy." The title is misleading, since by far the greater number of the chemical compounds the optical properties of which are described are not found in Nature, and hence are not 'minerals' in the commonly accepted sense of the term.

The author's original intention was to prepare a descriptive mineralogy to include all inorganic substances the optical properties of which were sufficiently well known to allow them to be identified microscopically. Afterwards he wisely decided to eliminate for separate treatment the data collected with regard to all synthetic inorganic substances (which, however, include a considerable number of artificially prepared *minerals*). The work brings together a large number of observations widely scattered throughout many American and European scientific publications.

Abundant references to the original sources of information are given. The artificial 'minerals' are arranged in chapters under such headings as sulphides, halides, carbonates, silicates, etc.; on a system based on Dana's well-known scientific mineral classification. The description of each individual substance includes, so far as is possible, all those optical and physical properties usually given in complete descriptions of natural minerals, especially those properties used in the identification of minerals in thin slice under the microscope. At the end of the descriptive portion of the book two determinative tables are given, one for isotropic and the other for anisotropic substances. In the latter, uniaxial crystals are distinguished by the use of italics. In each table the compounds are arranged in order of increasing refractive index. Including as separate individuals those substances which, owing to variation in their refractive indices, occur more than once in the determinative tables, upwards of 700 chemical compounds are listed.

The book should prove of value and interest to mineralogists, inorganic chemists, physicists, and, to some extent, to petrographers. V. A. E.

Diesel Engine Design. By H. F. P. Purday. Third edition. Pp. xviii + 360. (London: Constable and Co., Ltd., 1928.) 21*s.* net.

IN covering the whole field of Diesel ... in a volume of about 350 pages, Mr. Purday has attempted a difficult task. It may be at once said that he has written a very good book, in which a noteworthy feature is the way in which he has treated all sections of the subject without overdoing those parts in which he himself is particularly interested.

The book is pre-eminently one for the draughtsman and for the student who is specialising: it can obviously not go far enough, in its limited space, for the engineer controlling design, while for the general student it must naturally treat too much of the details of actual design rather than of principles. It should be among the books of all interested in oil engines, and should find a place in the libraries of institutions where the subject of heat engines is studied.

The large number of figures in the text—there are more than 300—are well done, and add greatly to the clearness of the description. The bibliographical lists given at the ends of chapters are valuable, but there are unfortunately slips in them—for example, one reference appears twice in the same list under two slightly different titles. Vague statements which may mean almost anything should also be guarded against, such as "a pressure of about 1 lb. or even less." The nomenclature of the oil engine is still uncertain, so that it is perhaps scarcely fair to mention those cases where the terms used do not seem to be strictly accurate. Altogether, any criticisms can only relate to details, and the author is to be congratulated on having written one of the best books of its kind.

The Fatigue of Metals: with Chapters on the Fatigue of Wood and of Concrete. By Prof. H. F. Moore and Prof. J. B. Kommers. Pp. xi + 326. (New York: McGraw-Hill Book Co., Inc. London: McGraw-Hill Publishing Co., Ltd. 1927.) 20*s.* net.

EVERY advance in engineering practice makes new demands on the materials used in construction, especially in regard to their resistance to fatigue and to the action of prolonged stress. The authors of this book have themselves carried out exceedingly thorough investigations into the behaviour of steels and other engineering materials towards repeated stress, and these have been described in reports which are well known to all students of the subject. They have now written a manual of fatigue which will be indispensable to engineers. The treatment of the subject, a highly controversial one, is scrupulously fair, and the authors generously dedicate the volume to the British investigators who have done so much to advance this study. The various types of machine which may be used to produce alternating stress by bending, by tension and compression, or by torsion, are described and illustrated, and the results obtained by the several methods are compared. Numerous tables and diagrams sum up the results of tests, and the application to engineering practice is well illustrated by examples. On the theoretical side the treatment is cautious, and the account of changes in microscopic structure is rather meagre, so that the general effect on a scientific reader is less stimulating

than that of the work on the same subject by Gough, but the authors no doubt feel bound to extend the data still further before attempting broad generalisations. Some account is given of the relation between fatigue and 'creep,' which is of undoubted importance, and deserves further study. Short chapters on the fatigue of wood and concrete are added, and there is an excellent bibliography. Text and diagrams are clearly printed.

C. H. D.

Fundamentals of Dairy Science. By Associates of Lore A. Rogers. (American Chemical Society Monograph Series, No. 41.) Pp. 543. (New York: The Chemical Catalog Co., Inc., 1928.) 5.50 dollars.

THIS is a very valuable monograph which presents an up-to-date account of the principles upon which the dairy industry is based, and brings together the results of much research that has been prosecuted in this field. The contributors are, or have been, members of the staff of the Research Laboratories of the Bureau of Dairy Industry of the United States Department of Agriculture, and included in the list are several well-known names.

Part I. deals with the constituents of milk, the chapters on the proteins and the milk fat being of particular interest; in the latter is included a summary of the methods used in the examination of milk fat. Part II. is devoted to the physical chemistry of milk and milk products; the influence of physical conditions upon the separation of milk, the making of butter; the coagulation of milk and the making of cheese are treated very fully.

Part III. deals mainly with the bacteriology of milk and milk products. The sources of the bacteria are explained, as well as the effects they produce and the factors which influence their growth. Part IV. starts with the nutritional value of milk and discusses the part which it plays in the feeding of young and adult animals. The part played by milk in regard to the requirements of the body for vitamins is also dealt with. The final chapter is devoted to the physiology of milk secretion, the influence of food upon milk production, and especially the part played by the protein and fat of the diet.

The volume is excellent in every way; its arrangement brings out the results of inquiries which have often been neglected in books on dairying, and the list of references at the end of each chapter will be found most helpful to workers on the subject.

Materialprüfung mit Röntgenstrahlen: unter besonderer Berücksichtigung der Röntgenmetallographie. Von Prof. Dr. Richard Glocker. Pp. vi + 377. (Berlin: Julius Springer, 1927.) 31·50 gold marks.

THERE are now many text-books which deal with the examination of metals by means of X-rays, and the work of Prof. Glocker has many good features. It is excellently printed, and contains a full account of the various methods of obtaining X-ray spectra and of deducing from them the structure of metallic crystals.

The most modern types of X-ray tube are described, but the reader misses a discussion of the difficulties connected with their use, and a critical review of experimental methods. It is true that one worker will obtain good results with a form of apparatus with which another is entirely unsuccessful, but the reasons for differences in behaviour of different tubes have not, to the reviewer's knowledge, been examined in detail in a text-book. The subject of the examination of metals for defects by the absorption of X-rays is dealt with very briefly, and the main portion of the book is concerned with the determination of structure. The known data respecting space-lattices of metals and alloys are collected, whilst non-metallic substances only receive brief notice.

The most conspicuous defect is the almost complete neglect of English work, in a field in which this country has made such important discoveries. Even the work of the Braggs is only quoted from the comparatively elementary book by those authors, and not from original papers, and their collaborators are scarcely mentioned. As a review mainly of German work, however, the volume may be recommended as being both clear and thorough.

Biologie der Früchte und Samen (Karpobiologie). Von Prof. Dr. E. Ulbrich. (Biologische Studienbücher, herausgegeben von Walther Schoenichen, Band 6.) Pp. viii + 230. (Berlin: Julius Springer, 1928.) 12 gold marks.

A HANDBOOK on the biology of fruits and seeds has long been needed. This work only partly supplies the need. While the morphological aspects are adequately dealt with, considering the size of the book, the biological data given are less satisfactory. This is largely due to the relative neglect of field investigation and experiment by the majority of those who have studied fruits and seeds. Many biologists cannot feel satisfied that opinions stated as a result of herbarium and museum studies are trustworthy accounts of what actually happens in Nature. It is certainly risky to conclude that morphological peculiarities function for wide dispersal in the absence of observational and experimental facts, and deductions from analogical resemblances may be entirely misleading.

Prof. Ulbrich divides the main part of his subject on the basis of the agents of dispersal. Self-dispersal (autochory) is first considered. Agents external to the plant result in allochory, of which the following types are recognised: zoochory (animal dispersal, endozoic, synzoic, epizoic), hydathochory (water dispersal), and wind dispersal (anemochory). Short accounts of polychory, polycarpy, and vivipary conclude the book. An adequate index is provided, but the list of literature is far from complete, especially for English research. The work is well illustrated with fifty-one text-figures.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Experimental Proof of 'Negative Dispersion.'

THE intimate connexion between absorption and selective dispersion suggests that the process of 'negative absorption' implied by the Planck-Einstein theory of temperature radiation should be accompanied by a corresponding negative selective dispersion. The idea of 'negative dispersion' was first introduced by H. A. Kramers in his correspondence theory of the scattering and dispersion of light (see NATURE, 113, p. 673; 1924). It now appears also in the quantum mechanics of these phenomena.

By considering the dispersion of a gas only in the neighbourhood of an isolated spectral line connected

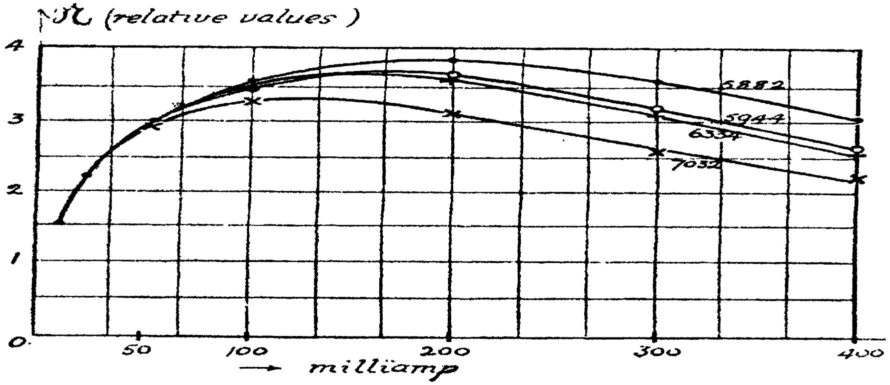


FIG. 1.

with the quantum states j and k, it follows from these theories, as well as from simple considerations analogous to the Einstein proof of the Planck formula (see R. Ladenburg, *Zeit. f. Phys.*, 4, p. 451; 1921: 48, p. 15; 1928), that the change of the refractive index will be proportional to the product

$$\frac{f_{kj}}{g_j}(N_j g_k - N_k g_j) = f_{kj} N_j \frac{g_k}{g_j}\left(1 - \frac{N_k}{N_j}\frac{g_j}{g_k}\right)$$

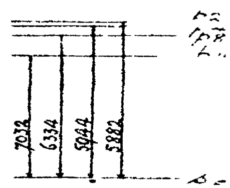
instead of to the number $\mathfrak{N}$ of dispersion electrons required by classical theory. Here N_j and N_k are the number of atoms per c.c. in the states j and k; g denotes the statistical weight of the state; and f_{kj} is the 'relative strength of the corresponding oscillator,' being proportional to the Einstein probability coefficient for the spontaneous transitions $k - j$, or to the square of the amplitude of the corresponding electric moment of the undisturbed radiating atom.

According to this formula the negative dispersion is determined by the expression $\frac{N_k}{N_j}\frac{g_j}{g_k}$. Usually this value, and therefore the amount of negative dispersion, is negligibly small. It will only be considerable if the gas is excited very strongly and if the difference of energy between the two combining states j and k is not too large.

Led by these considerations, we have succeeded in obtaining negative dispersion by extending our experiments on anomalous dispersion near the different spectral lines of electrically excited neon (see *Zeit. f. Phys.*, 48, p. 26 ff.; 1928) to high current densities (*c.* 1 ampere per cm.^{2}).

The results of our measurements of anomalous dispersion near the lines 5882 (s_5p_2), 5944 (s_5p_4), 6334 (s_5p_8), and 7032 (s_5p_{10})—all belonging to the same lower state s_5—are given in the accompanying diagram (Fig. 1). It shows the amount of anomalous dispersion, measured by the number $\mathfrak{N}$, on the amount of current passed through the neon tube of $\frac{1}{2}$ cm.^{2} cross-section. Only the relative $\mathfrak{N}$ values of the different lines, all reduced to a common scale, are represented. The absolute values of $\mathfrak{N}$ differ from each other according to our formula, by the factor of the 'relative strength' f_{kj}.

The common increases of the different s_5p_k-lines up to about 50 milliamperes correspond with the increase of the Ns_5 values of the atoms in the common lower state s_5 (see our previous experiments). At larger currents, however, the curves of the different lines behave in quite another way: after reaching a maximum value they all decrease again, but in doing so they separate considerably from one another; those of largest wave-length decrease most, and those of shortest wave-length decrease least, *i.e.* the smaller the difference of the energy between the common lower state s_5 and the different upper states p_k, the larger is the effect of decreasing.



This is just what we should expect as a consequence of negative dispersion and the influence of the expression $\frac{N_k}{N_j}\frac{g_j}{g_k}$ (j corresponds in our experiments to s_5, and k to p_2 or p_4, or p_8 or p_{10}). The larger the current the larger is the number of the atoms in the upper state p_k (according to our former experiments, above 50 milliamperes the atoms in the lower state s_5 do not increase much, as these states are continually destroyed upon electron impacts); and therefore the larger will be the relation N_k/N_j. Further, the number N_k of the atoms in the different upper states (that is p_{10} . . . p_2) will be greater the lower the energy of that state—as a consequence of a kind of statistical equilibrium (see our former experiments). The influence of the statistical weights also comes into play, as will be shown in a more close discussion of the experiments. It is theoretically very improbable that the electric field associated with the high current density should exert an effect upon the f-values so as to be responsible for the described phenomena. On the other hand, we have not succeeded in detecting a corresponding anomalous dispersion near the infra-red lines $p_k - d_i$; as a matter of fact, the lines are rather broad, so that the proof for anomalous dispersion is not very sensitive. Besides, it may be that the 'relative strengths' f of these lines, *i.e.* the probabilities of the spontaneous transitions, are not large enough for an appreciable amount of anomalous dispersion.

As a matter of fact, we meet with the same consequences in considering the action of negative absorption. In the Planck formula of temperature radiation, the -1 in the denominator $(e^{\frac{h\nu}{kT}} - 1)$ results from taking the processes of negative absorption into account. This -1 gives the whole difference between

the formulæ of Planck and that of W. Wien. It is well known, from the experiments of Lummer-Pringsheim and Rubens-Kurlbaum, that the difference between these two formulæ and also the validity of the Planck formula, come out the more clearly the smaller the relation ν/T, that is, the larger the temperature (or the excitement) and the larger the wave-length.

H. KOPFERMANN.
R. LADENBURG.

Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie,
Berlin, Dahlem,
July 28.

Wave Mechanics and Radioactive Disintegration.

AFTER the exponential law in radioactive decay had been discovered in 1902, it soon became clear that the time of disintegration of an atom was independent of the previous history of the atom and depended solely on chance. Since a nuclear particle must be held in a nucleus by an attractive field, we must, in order to explain its ejection, arrange for a spontaneous change from an attractive to a repulsive field. It has hitherto been necessary to postulate some special arbitrary 'instability' of the nucleus; but in the following note

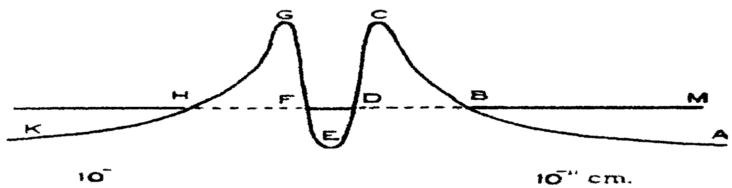


FIG. 1.

it is pointed out that disintegration is a natural consequence of the laws of quantum mechanics without any special hypothesis.

It is well known that the failure of classical mechanics in molecular events is due to the fact that the wave-length associated with the particles is not small compared with molecular dimensions. The wave-length associated with α-particles is some 10^5 smaller, but since the nuclear dimensions are smaller than atomic in about the same ratio, the applicability of the wave mechanics would seem to be ensured.

In the classical mechanics, the orbit of a moving particle is entirely confined to those parts of space for which its potential energy is less than its total energy. If a ball be moving in a valley of potential energy and have not enough energy to get over a mountain on one side of the valley, it must certainly stay in the valley for all time, unless it acquire the deficiency in energy somehow. But this is not so on the quantum mechanics. It will always have a small but finite chance of slipping through the mountain and escaping from the valley.

In the diagram (Fig. 1), let O represent the centre of a nucleus, and let $ABCDEFG$ represent a simplified one-dimensional plot of the potential energy. The parts ABC and GHK represent the Coulomb field of repulsion outside the nucleus, and the internal part $CDEFG$ represents the attractive field which holds α-particles in their orbits. Let DF be an allowed orbit the energy of which, say 4 million volts, is given by the height of DF above OX. Approximately, we can say that with this orbit will be associated a wave-function which will die away exponentially from D to B. Again, corresponding to motion outside the nucleus along BM, there will be a wave-function which will die away exponentially from B to D. The fact that these two functions overlap in the region BD means that there is a small but finite probability that the particle in the orbit DF will escape from the nucleus along BM, acquiring kinetic energy equal to the height of $DFBM$ above OX, say 4 million volts. This occurrence will be spontaneous and governed solely by chance.

The rate of disintegration, that is, the probability of escape, depends on the amount of overlapping of the wave-functions in the regions DB and FH, and this is extremely sensitive to the height to which the potential curve at C rises above BDF. By varying this height through a small range we can obtain all periods of radioactive decay from a fraction of a second, through the 10^9 years of uranium, to practical stability. (In considering the transmutation of a molecule into its isomer, Hund found a similar vast range of transformation periods, *Zeit. f. P.*, **43**, 810; 1927.) If the potential curves for the interaction of an α-particle with the various radioactive nuclei are similar, we can obtain a qualitative understanding of the Geiger-Nuttall relation between the rate of disintegration and the range of the emitted α-particles. For the α-particles of high energy the wave function for outside motion will overlap that for the inside motion more, and the rate of disintegration will be greater.

Besides obtaining a general idea of the mysterious instability of the nucleus, we can visualise in this way one of the most puzzling results of recent experimental work. An α-particle having the same range (2·7 cm.) as those emitted by uranium should, if fired directly at the uranium nucleus, penetrate its structure; while faster α-particles should do so, even when not fired directly at the nucleus. It was therefore disconcerting when, on examining the scattering of fast α-particles fired at uranium, Rutherford and Chadwick (*Phil. Mag.*, **50**, 904; 1925) could find no indication of any departure from the inverse square laws. But from the model outlined above, this is what would be expected. For if the height of BM above OX represents the energy of the uranium α-particles, then a faster particle fired at the nucleus will simply run part way up the hill ABC and return without having encountered any change in the repulsive field or any nuclear particles (which are describing orbits within the region GEC).

The peculiar property of the wave mechanical equations which finds application here has also been applied to the theory of the emission of electrons from cold metals under the action of intense fields (Oppenheimer, *Proc. Nat. Acad. Sci.*, **14**, 363; 1928; and Fowler and Nordheim, *Proc. Roy. Soc.*, A, **119**, 173; 1928). Ordinarily, an atom does not lose its electrons because the attractive field of the atom remains attractive to all distances. But when an intense field is applied, then the attractive field is reversed in sign a short distance from the atom. This makes the resultant potential energy curve similar to that in the diagram, and so the atoms begin to shed their electrons.

Much has been written of the explosive violence with which the α-particle is hurled from its place in the nucleus. But from the process pictured above, one would rather say that the α-particle slips away almost unnoticed.

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July 30.

X-Ray Studies of the Structure of Salts Adsorbed on Cellulose.

THE ability of cellulose to take up salts from aqueous solutions and retain them upon drying is well known, but little has been shown as to the condition in which they are retained. The following possibilities which might be distinguished by X-ray analysis are suggested: (1) a mechanical holding, in which both cellulose and the salt retain their original structure; (2) a reaction forming a new structural arrangement; (3) a molecular or ionic dispersion of the salt throughout the cellulose units, the cellulose being structurally unchanged. It has just come to our attention that Ruff, Ebert, and Luft (*Z. anorg. allgem. Chem.*, **170**, 49; 1928), in an X-ray study of salts adsorbed on activated carbon, found in the majority of cases no evidence of the presence of the salts in their crystalline state. This observation would correspond to the third possibility.

Our X-ray examination of salts adsorbed on cellulose has shown that up to a certain 'saturation concentration' of the salt, the third possibility is the correct one. Above this concentration the excess salt has its characteristic structure, and probably corresponds

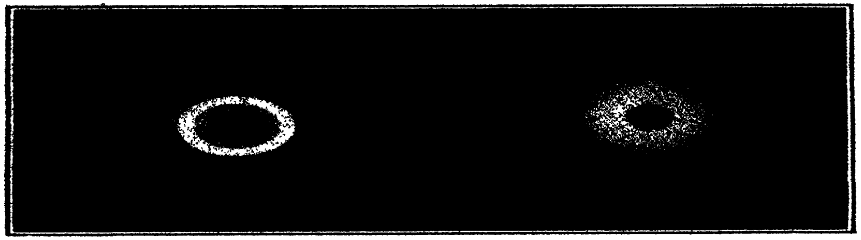

FIG. 1.—Tungstate–starch pattern, before wetting. FIG. 2.—Tungstate–starch pattern, after wetting and drying.

to the first possibility. In no case did we observe any evidence of a new structural arrangement.

Investigations were made with cellulose both in the form of starch and as filter paper. The two salts studied were NaCl and $Na_2WO_4 . 2H_2O$. Varying amounts of salts (from 0–10 per cent sodium chloride and 0–35 per cent tungstate) were soaked into weighed samples of filter paper, which were dried and re-weighed. Ten thicknesses of the paper served as a specimen. The starch was mixed with the salt in the desired proportions, wetted with a few drops of water, and dried in a desiccator. The specimen containers for the starch were $\frac{1}{16}$-inch metal strip, with $\frac{1}{4}$-inch hole, covered on both sides with thin cellophane windows. The wetting process took place in these specimen containers. The powder diffraction method was employed, using unfiltered radiation from a Coolidge molybdenum target tube operated at 30 k.v. (eff.).

To have standards for comparison, diffraction pictures were taken of the filter paper alone; salts alone; filter paper with salt mechanically rubbed in until its salt content equalled that of the 'soaked in' specimen; and the starch–salt mixtures before wetting. The 'rubbed in' sodium tungstate specimen showed the superimposed patterns of the salt and of the paper, as would be expected. The tungstate–starch series before wetting (Fig. 1) also showed the two characteristic patterns, over all concentration ranges investigated.

After wetting and drying, however, the tungstate pattern disappeared entirely at all concentrations below a point between 25 and 35 grams per 100 grams of starch, leaving only the unchanged starch pattern (Fig. 2). The filter paper series showed the same disappearance of the tungstate pattern at a corresponding concentration. Above this concentration in each case both the cellulose and the salt patterns appeared.

This phenomenon indicates that below a certain concentration the salt is molecularly or ionically dispersed. Above this concentration crystals of the salt exist as such. At no concentration was there evidence of any new structure.

The sodium chloride–starch study was similarly carried out, and with identical results, except that the 'saturation concentration' was much lower (in the vicinity of five grams per 100 grams of starch). Since the ratio of 'saturation concentrations' of the two salts is approximately six to one, and since their molecular weights are in a similar ratio, it seems quite probable that the phenomenon is a molecular one. Thus these 'saturation concentrations' would be more properly expressed as molecular concentrations than as weight concentrations.

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July 24.

The Island of San Matteo.

LOOKING at an old map of Africa last year, I noticed an island named San Matteo about half-way between Ascension and the Gold Coast. My curiosity was aroused, and in the past eighteen months I have examined more than a dozen maps dating from the sixteenth to the eighteenth century, including the two oldest maps of Africa in the Vatican library. In every case San Matteo is indicated in approximately the same position. Lately, a French map of 1722 has come into my possession, which gives the following note: "Isle St. Mathieu découverte par les Portugais l'an 1526. Il y a une Source de Bonne Eau." The position of the island on this map is lat. 2° S., long. 16° E. of Ferro. Is it likely that a Portuguese navigator could have been so far out of reckoning, both in latitude and in longitude, as to have rediscovered Ascension without knowing it? Or did San Matteo really exist? S. J. SHAND.

Stellenbosch, South Africa,
Aug. 2.

THE recurrence on a large number of maps, for at least two centuries, of the supposed Island of St. Matthew in the position named by Prof. Shand is a striking example of the vitality of error when once established. At the moment I am unable to trace a previous discussion of the question, but the following seems a possible solution of the problem.

There seems little doubt that the legend on the French map of 1722 was based directly or indirectly on a story told by the Portuguese historian Barros, Dec. I, Liv. 2, Cap. 2 (edit. of 1778, I. 1, p. 147), which had no doubt been current before he wrote in 1552. The story, given under the date 1525, comes at third hand from a Portuguese pilot, who told of having touched at an uninhabited island named S. Mattheus, in which were two watering places, one good, the other not good; and of an inscription seen on two trees which recorded that Portuguese had been there 87 years before. The island of S. Thomé in the Gulf of Guinea is spoken of in the same passage, so the

ference would seem to be to an island in the same gion. I find, in fact, in the "Hamy" Chart of out 1502, a name which may possibly read "Y. de S. atteo" applied to one of the islands in the gulf. oreover, in Sir George Peckham's discourse on 'estern Planting, printed by Hakluyt (Maclehose's dition, viii. p. 127), 'S. Matthewe' is named along ith Principe, Anobom, and S. Thomé, as an island nder the equinoctial line, peopled by the Portu- 1ese.

The shifting of the island to a very different longi- ide need cause no surprise in view of the vagueness the early records, and could easily be matched by her similar instances. An excuse for so placing it ight perhaps be found in the marking of an island, the exact position eventually adopted for Saint atthew, in a Portuguese MS. chart of about 1516, cribed to the Reinels. Here the island is named Trynidade,' due possibly to confusion with the land of Trinidad in the S.W. Atlantic, discovered 1502 by Estevão da Gama. But like Ascension which was an alternative name for the latter Trinidad) e name was no doubt bestowed on many different lands.

The earliest map in which I have so far found the stitious island is the famous Ribero map of 1529. ater it reappears regularly in the charts of the esceliers School of Dieppe, in the Portuguese charts the Homems, in the Italian engraved maps of astaldi and others, though the name is not always e same nor always clearly legible. It is *not* to be und in the MS. chart of Pero Fernandez of 1528. ossibly some other correspondent may be able to ve a more certain explanation.

E. HEAWOOD.

Contractions for Titles of Periodicals.

THE letter from Capt. Sheppard, under the above tle, in NATURE of Aug. 25, raises a question of no ttle interest and importance to all those who are ncerned in any way with the use of scientific eriodicals, for the general adoption of a standard list contractions for the titles of periodicals is much eded.

Unlike Capt. Sheppard, however, I can see no ason why the list given in the "World List" should ot be used for this purpose. It is immaterial that do not all agree with the contractions used for e individual words. Should we ever agree? The oint is that here is for the first time a very carefully ompiled and complete list, with a ready key to the bbreviations used, and if it were universally adopted, hatever blemishes it contains would soon be lost ght of in the advantages that would be provided.

Capt. Sheppard's criticism that the contractions for e separate words are not uniform is, I think, beside e point. The compilers of the list have, as it seems me, disregarded the separate word entirely and ave taken the whole title as the unit. They have ttempted so to contract the title as a whole that this comes quite short and is yet distinguished from all ther titles in the list. That is why *Argus* is not ualified by the place of publication—there is no ther title *Argus*, and therefore no chance of con- sion. Where there is likely to be confusion, a istinction is drawn—as, for example, *Farmer, Chicago*, nd *Farmer, St. Paul*. For quite obviously, the econd volume of the "World List" containing the ontractions is intended to be used with the first olume, to which it is cross-referenced by the numeri- order of the entries. An inquirer does not have guess what *Argus* means. He turns up Vol. 1 and, y means of the number given against the contraction, once finds the full title and of publication.

There is, it is true, a snag here which must be avoided when tracing a contracted title. For the contractions, being in the exact order of the full titles, are not always in strict alphabetical order among themselves. Thus the contraction *Ann.* has five distinct alphabets representing in the full list *Annaes*, *Annalen*, *Annales*, *Annali*, and *Annals*, and care must be exercised to ensure that a contraction is being looked for in its proper group. But a little experience of the list will soon accustom a reader to the arrange- ments of such entries as this, and no difficulty should arise. (*Glasers Ann.* is perhaps a glaring example, for it occurs amongst the *A's* where it would certainly not be looked for, but in this particular case the periodical is so well known that few should be misled.)

There is no other list in existence so compre- hensive, and to the compilation of which so much thought has been given, and it will be a pity if, instead of making use of it, we waste our time in arguing over details which, after all, will always remain matters of opinion.

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Isotopes of Neon.

IN one of his earlier papers, Aston (*Phil. Mag.*, **39**, 444; 1920) found three isotopes of neon, Ne^{20}, Ne^{21}, and Ne^{22}. Distinct indications of Ne^{21} were obtained only on the clearest spectra, and he estimated that, if this constituent exists, its proportion was probably less than one per cent. In his more recent work (*Proc. Roy. Soc.*, **115** A, 487; 1927) apparently no evidence of the isotope Ne^{21} was obtained.

In a study of the ionisation process of methane, using a mass-spectrograph of the Dempster type, we have had occasion to use neon as a calibrating gas, and, under a great variety of experimental conditions, we have always observed an ion with a mass 21 corresponding to Ne^{21}. This ion was never observed when neon was absent, nor could it be a hydride of Ne^{20+}, since it was obtained with pure neon and no corresponding ion of mass 23 was found.

There are, then, three isotopes of neon, as was first reported by Aston, and we estimate that atmospheric neon is composed of about ten per cent Ne^{22}, two per cent Ne^{21}, and the remainder Ne^{20}.

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Corpuscular Theory.

HAVING been urged to direct attention to a paper by myself read to the British Association fifty years ago, on a corpuscular-wave-theory of light, founded upon Le Sage's theory of gravity, I sent a letter to NATURE which appeared in the issue of Sept. 8. In that letter I say that, in 1878, the chief difficulty seemed to relate to refraction, and the reduced velocity of light in a dense medium. I ought to have added that the hypothesis that then seemed the most suitable for explaining the diminished velocity of light in dense media is due to the necessary wriggling of ultramundane corpuscles round the atoms, thus lengthening the distance to be traversed, and diminishing the velocity of the wave-front.

GEORGE FORBES.

The Relation of Physiology to other Sciences.[1]

By Prof. C. LOVATT EVANS, F.R.S.

PHYSIOLOGY AND THERAPEUTICS.

FROM the earliest times physiological knowledge, whether known by that name or not, has had the closest association with medicine. It would indeed be difficult to imagine any great advance in one that was not immediately reflected in the other. Their methods, though necessarily different, are convergent, their meeting-point being the disclosure of normal functions. It is the business of the physician to attend to the urgent call of pain and disease, and to use for their relief such information as he has at his disposal. As he does so he observes, compares, and draws conclusions on the basis of which a theory of the causation of the disorder may be built. The clinical observations and deductions drawn from them give a basis of rational physiological theory from which we have learnt that a state of disease is never a thing in itself, but is always a result of a quantitative change in some physiological process, an increase or diminution of something that was there to begin with.

No aspect of scientific activity is so generally misunderstood as that which concerns the making of discoveries, and in matters of medical research ignorance is particularly widespread. Discoveries are infrequent, in a sense fortuitous, and often dependent on rare qualities of intellect as well as on accurate observations, and they mostly come out of the fullness of time. We all feel great pride in recalling that one of the greatest of all discoveries, which has recently been celebrated as the tercentenary of the publication of William Harvey's famous book "De Motu Cordis," was made in our own country. Here was a genuine revelation that put old facts in a new light.

Incidentally it has been claimed, with more audacity than insight, that experiments upon living animals serve no useful purpose, and it has even been pretended that Harvey had no need for such experiments in the classical researches which formed the foundations of physiology and gave reason to physic. Riolan, in advancing against Harvey the criticism that "it is a mockery to attempt to show the circulation in man by the study of brutes," was, as Gley has recently remarked, "already employing the argument, if it can be called one, which is encountered under the pen of the antivivisectionists of all times, and which illustrates the diuturnity of ignorance and folly."

Let anyone with sufficient acquaintance with physiology try to write an account of such of the main facts concerning the functions of the heart and of the circulation as are most valuable in medicine, without reference to any fact obtained directly or indirectly by animal experimentation, and he will find his essay a very sorry one indeed: for no doctor can use a stethoscope, feel a pulse, take a blood-pressure, administer a hypodermic, give an anæsthetic or a transfusion, perform any modern operations, or indeed take any steps in diagnosis, prognosis, or treatment, without utilising at every turn knowledge derived from the results of animal experimentation and obtainable in no other way.

The subject of pharmacology is very closely connected with physiology on one hand and with therapeutics on the other. Rational therapeutics, based on the results of pharmacological study, also will carry into the wards the spirit of true scientific investigation, and the provision of beds in some hospitals for the use of the professor of therapeutics is an indication that definite progress is being made in this direction. Such an advance has not come before it is needed. If the medical practitioner is to compete successfully with osteopaths, chiropracters, and other similar unqualified persons, he is most likely to do so by only prescribing treatment with proper scientific basis. He should be able to form some opinion with regard to the claims of advertisers of remedies who contribute so large a share towards his daily mail deliveries.

It is, in my opinion, quite impossible, and perhaps undesirable, at the present time to frame instruction in physiology so as adequately to equip the ordinary medical student to proceed directly to the prosecution of research in any of its branches; this can only be achieved by a further year or two of study of the subject, such as by a science course for an honours degree. One of the objects of instruction is to enable the latest results of physiological investigation to be utilised in the clinic, and it seems to me that one of the best ways for this to be effected is for some workers specially trained in physiological methods to enter the staff of clinical units where facilities for research work are at hand.

The opinion was at one time prevalent among many clinicians, that if their problems required the use of methods similar to those of experimental physiology, these should be farmed out to a physiologist, and although there are cases where this procedure may be followed with advantage, the rich harvest which has already been reaped by the importation of physiological knowledge and methods into, rather than the export of problems from, the clinic, is adequate justification for the former. It is in any case encouraging to note the present-day decline of the attitude that experimental investigation is work of a lower order, which can be put out like so much washing, for the employment of an inferior caste.

The close connexion which is now generally admitted between physiology and medicine was clearly foreseen by Claude Bernard in 1855. Medicine, he said, is a science, and physicians who describe it as an art injure it, because "they exalt a physician's personality by lowering the importance of science." "True experimenting physicians," he says, "should be no more perplexed at a patient's bedside than empirical physicians. They will make use of all the therapeutic means advised by

[1] From the presidential address to Section I (Physiology) of the British Association, delivered at Glasgow on Sept. 10.

ıpiricism ; only, instead of using them according authority and with a confidence akin to super- ;ition, they will administer them with that hilosophic doubt which is appropriate to true xperimenters."

Physiology takes its place as a science in pro- ortion as its data are accurate and its principles all into line with those in the other sciences. My reat teacher Starling said that science has only ne language, that of quantity, and but one argu- ıent, that of experiment. The qualitative ob- ervations of one generation tend to become uantitative at a later stage of development of a cience, and the degree of development of a science an indeed to some extent be judged by the extent which it falls into a scheme of the unity of science y giving results which are capable of mathemati- al treatment and of expression in broad general rinciples.

What has happened in physics and chemistry ay be reasonably expected to happen in biology, soon as it is able by improvement in the accuracy its methods and by progress in the formulation its problems to employ mathematics with profit the manipulation of data and in the construction those generalisations which are landmarks of rogress in all the sciences ; indeed we are, I think, w witnessing the commencement of such a phase the development of our own subject.

Mathematics and mathematical physics have een of considerable use to physiology in increasing he accuracy of its experimental data, and this in wo ways. First, by bringing the accurate experi- ıental and intellectual methods of physics to bear n the construction and use of the numerous hysical instruments which it employs. It has een said by Prof. A. V. Hill, that many of the arly investigations on muscle were in reality tudies of the properties of levers, and it is certain hat similar remarks apply to only too many in- estigations in which the properties of the apparatus ised have not been suitably investigated.

Even when the apparatus at the disposal of the hysiologist is unexceptionable, however, it is ften the fact that, owing to the nature of the ubject, results are not susceptible of repetition vith the same ease and certainty as are those of hemical or physical experiments. The variability of the results is due in such cases to what are called accidental circumstances, a term which in reality neans circumstances over which we have no con- rol, owing either to our ignorance of their nature, or else to our inability to alter them. In those cases where further study provides methods of more fully understanding and therefore more ade- quately controlling these circumstances, valuable results follow almost at once.

Under the most favourable conditions, however, it has up to the present been usual to find a con- siderable unavoidable margin of variation in the results of many physiological experiments. By regarding these provisionally as 'chance' varia- tions, considerable help may be obtained by the application of the theory of errors, based on the theory of probability.

, as a means for evolving generalisations out of experimental data, and of bringing these into relation with the generalisations of other branches of science, the use of mathematics is incontestable. One need only mention as examples the fresh out- look which has been provided for further investiga- tion by the exact study of the data relative to the segregation and recombination of hereditary factors, the beautiful investigations of L. J. Henderson on the equilibria in the blood, the theoretical study of the phenomena of excitation, the employment of thermodynamics and the numerous other applica- tions of physico-chemical theory.

Chemistry and physiology having both originally sprung from the art and practice of medicine, it is little matter for surprise that such a rich harvest has been reaped by their reunion in the form of biochemistry. Although these developments were foreshadowed by the intuition, if not by the actual achievements, of the iatro-chemists of the six- teenth century, little advance was possible until chemistry had, by separation from medicine, established its position as an independent science. So that it was not until about 1840 that organic chemistry and biochemistry were able, chiefly owing to the inspiration of Liebig, to make rapid progress, at least on the Continent. It is signifi- cant that at the present time a steadily increasing number of young highly trained organic chemists consider it worth their while to turn to bio- chemistry ; their welcome entry into our ranks gives us fresh hope and faith in our future, as well as in theirs.

As is usually the case, rapid developments in biochemistry have followed improvements of technique ; the advances in micro-methods of analysis, without which insulin would probably not have been discovered, or the constitution of thyroxin made known, have played a very import- ant part ; the same applies to the whole subject of physical chemistry, much of which, like colloid chemistry and the theories of buffer action, has been built up in response to biochemical re- quirements. Since the central problems of bio- chemistry are dynamical, most of its subject matter must be treated from that point of view, and here again the debt to physical chemistry must be recognised.

Whether a biochemist should be primarily a chemist or a biologist is a question which has been much debated in private, though little in public. Personally I see no reason why he should not be both. If he must have one label, it is better that of the chemist, provided always that the bio- chemist works in the closest possible association with the physiologist. In fact, I am convinced that within the limits of administrative possibility, the greater the variety of workers brought together the better the results.

So much for the exact sciences. Their value to physiology is immense. They help us to interpret phenomena, but not to predict. In a word, physio- logy is something more than biochemistry and biophysics ; it is, and will always remain, a bio- subject.

As its nearest neighbour among the biological sciences, zoology should have the closest relations with physiology, yet it is curious that during several decades, for reasons which need not now be discussed, these two subjects were as the poles apart. The newly disinterred subject of comparative physiology, however, bears witness to a returning interest of zoologists in the experimental study of function as against mere morphological classification, as well as of physiologists in comparative function as a valuable means of throwing light on their own special problems.

The relation of anatomy to physiology can best be understood if we recall the fact that when the time was ripe physiology separated off from anatomy, taking with it all those dynamic problems which concerned function, and leaving anatomy literally little but the dry bones. The stationary condition of anatomy during the last decades of the nineteenth century was similar to that of zoology, and indeed had similar causes, and was little relieved by the subsequent incorporation of anthropology and embryology.

Histology had in most countries remained with anatomy, and had for the most part been content, like it, merely to describe the structure of preserved dead things. In Britain, it is true, histology had until quite recently everywhere remained with physiology, and had perhaps fared no better, for although the British, like their Continental friends, did 'nothing in particular,' they did not do it very well, for we must admit that histology had degenerated into a merely descriptive subject, supplemented by training in a useful technique, and by the identification of specimens. Nevertheless there were rays of hope, and occasional hints, that the problems of function had not been entirely lost sight of, and that the large mass of histological information which had been collected might become valuable if only the fundamental question as to the reality of the structures described could be settled.

At the present time some English schools have followed the American and Continental practice, and handed histology over to anatomy and though I am personally not at all convinced of the justification of this step, yet in view of the indications of quickening in the subject of anatomy during the past two decades, it no doubt is best to suspend judgment as to the ultimate result of the transfer.

I have, I hope, said enough to lend emphasis to my principal point, which is that the subject of physiology has the most intimate and vital contact with all biological subjects, with the fundamental sciences, and with medicine. It is, in fact, one of the best possible illustrations of Herbert Spencer's idea that "the sciences are arts to one another." It has often been said that science knows no frontiers and no nationalities. If we apply this a little nearer home, we shall all look forward to the day when departments will merely indicate administrative boundaries and not intellectual compartments.

Although the application of those sciences which are called 'exact' is of immense value to physiology, we must be under no misapprehension as to their real relation, which is merely that they enable the phenomena of life to be described more accurately. They in no way furnish an explanation of those phenomena or enable us, without direct reference to physiological facts, to forecast them. The so-called exact sciences appear to be so because of the simplifications of which they are capable, by reason of which problems can readily be formulated and attacked. Disturbing conditions can provisionally be ignored or allowed for, and a first approximation reached which can be corrected later. In biology this can less readily be done. It is the failure to appreciate this elementary fact which leads some of those trained only in the methods of the exact sciences into the most palpable and unpardonable blunders when they attack biological problems.

The process of application of the exact sciences to physiology consists in reality of studying the phenomena themselves and then adopting the most plausible explanation capable of formulation in terms of the exact science. There is no other way. But let us be under no illusion about finding final explanations of what life is by this or any other methods.

It was pointed out long ago by Claude Bernard that all *a priori* definitions of life, like those of time, space, or matter, are futile, since they usually themselves imply the thing defined. Let us take one or two famous definitions of life as examples. Bichat in 1818 defined life as "the sum total of those functions which resist death." Here we have two opposed ideas, life and death. "All that lives will die; all that is dead has lived." For Bichat, life is a struggle of the living thing against an environment which seeks to destroy it, but it is clear that the idea of life as opposed to death is implicit in the definition. This idea of an internal teleological principle, of entelechy, runs through all biological writings back to Aristotle, with whom we believe it to have originated. The amœba which encysts itself does so in order to defy adverse conditions in its environment. The 'calculating intelligence' postulated by Kant directs this response.

Another definition of life which has been much favoured of late is the mechanistic one in various forms; 'life is a special activity of organised things.' Here again the definition implies the idea itself. The possession and maintenance of a definite structure cannot any longer be held to be an outstanding feature of living matter as commonly understood, for recent researches in physics show us that, although electrons may come and go, the atomic structure of matter is relatively stable, even though in particular circumstances mutations may occur. Nevertheless, the view of life as a mechanism created by and entirely dependent upon its environment gained strength owing to the developments in other sciences, particularly by reason of the synthesis of organic compounds, the principle of the conservation of energy and the introduction of the Darwinian theory of evolution. According to this view, a revival of that of Empedocles, teleological manifestations are accidental. As that

thoughtful writer Hjort remarks, however: "When we, as human beings, call a thing accidental, it only means that we give up the hope of understanding it. . . ." "In the physical sciences those factors are termed accidental which we voluntarily disregard in the course of an investigation, or which we find we have omitted to notice." Kant, however, in his "Kritik of Judgment" calls the teleological "the link whereby our understanding can alone be supposed to find any agreement between the laws of Nature and our own power of judgment."

Mechanistic interpretations tend in the long run to become arrogant and superficial, as vitalistic ones predispose to scientific nihilism. For, while it is inconceivable that living things do not obey the laws of Nature, yet it is equally unthinkable that a chance encounter of physico-chemical phenomena can be the explanation of their existence. This being so, how can we, in Kant's words, "arrive at an understanding of Nature"?

It seems clearly impossible to harmonise or to decide between these opposed views of the nature of life, and I do not think any final conclusion to be possible or even necessary. To quote Hjort once more, "Philosophy has no other starting-point than a problem, and the current results of scientific research; it never leads to any absolute conclusion. It grows with the science of Nature, since in reality it comprises the most general results of that science and comprises nothing more. It does not explain the nature of the human understanding, and provides no means of getting behind the understanding itself . . . the existence of which is the first and necessary condition for the existence of science at all."

Physiologists, in attempting to know what life is, have in my opinion attempted too much, and I think that a new point of view is essential. One of the greatest of contemporary thinkers, L. J. Henderson, has recently submitted an argument with which I venture humbly to agree. The idea of adaptation, urged by Claude Bernard, should be adopted by physiology as its basal principle, as the chemist accepts the conservation of matter, or the physicist the conservation of energy. We need not seek to know why it is so: that is the province of the philosopher; all our experience tells us that it is so. It is not a definition of what life is, but a brief statement of its way, which is valuable, stimulating, and true. But we must treat the organism and its environment as one if we are to gain a proper insight into the adaptations manifested by the former. Life is conserved by adaptation, and I think that this conception will be useful alike to general biology, to physiology and perhaps most of all to pathology.

It is the concern of physiology to study the normal functions, and here the normal must be regarded as a statistical group. For particular purposes it is convenient to consider normals as of fixed value; but for other purposes it is equally convenient to regard each of these in turn as variable, to study its variations and find how they are produced. When we do so, we find, with increasing clearness the more deeply the subject is investigated, that the variability and the constancy are closely related, the fixed value of one thing being due to the interplay of the variables of others.

We have in the study of physiology many beautiful examples of this closely woven texture of interdependent phenomena. Modify any condition concerning any one of them, and we at once set the machinery moving in such a way as to counteract what we have done; and this is not what life is, but what it does, which distinguishes it—it adjusts the organism to its environment.

Glancing now towards the future, what may we say represents in a few words the trend of modern physiology? In many ways a great future lies before it. Utilising the other sciences as its tools and itself reacting powerfully on them, we can confidently predict progress to undreamt-of heights, an enormous development of experimental pathology and medicine, and far-reaching effects on economic and sociological conditions. Yet, implicit in these very potentialities, there is another and a gloomier side to the picture. The rapidly accumulating wealth of detailed knowledge and of special technique demands an increased specialisation; unless there is a periodic intellectual stocktaking, there must inevitably be a loss of perspective and of grasp of great general principles.

The establishment of special research professorships, however profitable in isolated cases, cannot in my opinion make good this growing specialisation, because it will tend to divorce research and teaching and place the teaching professor on a level of real or apparent inferiority. The idolisation of research for the sake of the advancement it brings is another of the dangers which threaten us. If there is one thing worse than 'a mediocrity who does no research' it is 'a mediocrity who does.'

There are at the present time a large number of junior research posts available, but not enough well-trained people adequately to fill them. This is all to the good provided that those who on trial show no aptitude for the work can be ruthlessly eliminated. As they often cannot, there are in consequence a number of young people who drift from one research scholarship to another, perhaps not aimlessly, but with no better objective than the manufacture of papers designed to justify their employment. The hapless editors of each of the swelling tide of journals are coaxed, hoodwinked, and, if necessary, bullied, to ensure that these papers see the light of day. In the fullness of time the list of short-time research posts is exhausted, and the young investigator must now either turn to some entirely different occupation or else, as one of my friends expressed it, 'subside into a professorial chair' for which, incidentally, he is probably entirely unfitted.

The pursuit of science is nowadays, perhaps unfortunately, a career, and one in which moreover it pays to advertise. Science, we are often told, is the cream of civilisation. If we believe this, let us use all our endeavours to ensure that it be not a whipped cream, specious, puffed up with wind, and presenting a fictitious appearance of solidity.

Secondary Schools and Examinations.[1]

By CYRIL NORWOOD, D.Lit.

THE public schools and the great day schools of the nineteenth century were inspired both in regard to curriculum and method by Oxford and Cambridge, and they were largely classical; a reaction against this undue narrowness led to the experiment of the organised science schools of the last ten years of that century. These in their turn certainly carried the reaction too far, and produced juvenile chemists and physicists without culture or general education. In 1904 the Board of Education issued its first regulations for secondary schools, and sought something broader than either of these two rival institutions; they established a four-year course in which English, geography, and history, at least one language other than English, mathematics, science, and drawing should be studied, together with manual work, physical exercises, and, for girls, housewifery. As that course has been worked in practice in the last twenty-five years, it has been in the main academic in spirit, and the important subjects have come to be the native tongue, the foreign language or languages, and mathematics and science; the schools have continued to look to the universities, and to the development of those advanced courses which lead up to university studies. All this effort has been directed and stabilised, and some would say stereotyped, by the setting up of the system of school certificates, for which in England and Wales eight university authorities examine. All the secondary schools, therefore, have in the main the same outlook, which is primarily that each pupil should at the end of the first stage of the course be able to matriculate at a university; the school certificates have been brought into relation with the matriculation examinations, and the system is now organised in all its details.

Meantime the number of schools, and the number of pupils at each school, have greatly increased. In 1904 in England the number of secondary schools for boys, for girls, and for boys and girls together was 575; there are now 1184 recognised for grant by the Board of Education, and 305 recognised as efficient, but not eligible for grant. In 1904 the number of pupils was 97,698; in October 1927 it was 349,430, and if you add the 57,655 in the schools not eligible for grant you get a total of 400,000 boys and girls who are in England pursuing a course of secondary education. While the content of secondary education has not changed, and remains academic in spirit and outlook, the number of schools has more than doubled, and the number of pupils has increased by more than four times. To put it clearly in another way, in the first year in which the school certificates examination was held, there were 14,232 candidates; for the last one for which figures are available there were 54,593, again very nearly an increase of four times.

The result of pouring all this mass of new material into a single mould has produced a slowly increasing volume of protest, but those who protest are much more sure in describing the symptoms of the distresses of the secondary schools than they are in pointing to their cause or in finding the cure. It is said that there is a good deal of overstrain among the pupils of the secondary schools, particularly among the girls, and that for the average, the effort of reaching a satisfactory level in English and English subjects, in a foreign language or languages, and in mathematics and sciences is too much.

That this is so is shown by the fact that when the examination was established it was supposed that nearly all would be successful at the end of their course in obtaining a school certificate, but as a matter of experience less than two out of three have been able to do so. It is alleged that the examination hampers the freedom of the teacher, who during the whole four years' course can never turn aside to browse in the pleasant paths of literature or to pursue interests common to himself and his class, but must concentrate the attention of his class and himself wholly upon what will pay in the examination room. Great schoolmasters of the past are quoted who could never have pursued their favourite methods with success under present conditions. It is asserted that for many boys, and for still more girls, the present curriculum is unsuitable, that they are not all, or indeed comparatively many, of them going to the universities, and that they ought not to be sacrificed to the interests of the few who do contemplate that course. The question is raised whether as a matter of fact the intellectual training of the girl ought to be the same as that of the boy, and whether the tyranny of imposing the preparatory curriculum of the university upon the girls is not even more unreasonable than it is asserted to be in the case of the boys. On this point the committee which reported on the differentiation of the curricula as between the sexes spoke with an uncertain voice, probably because they knew that there were many feminine associations ready to tear and devour any committee or any individual who said anything which might be taken to imply that women were not the full equals of men, and girls of boys.

The practical outcome of all this is the suggestion that boys and girls should be awarded a school certificate even if they omit a foreign language entirely, or mathematics and science entirely, so long as they make up for it by proficiency in subjects such as music, art, handicraft, housecraft, and other subjects of more motley character and more dubious claim. On this proposal the English teaching profession is divided, the Headmasters' Conference and the Assistant Masters' Association being against it, the Headmasters' Association doubtfully in favour, and the Headmistresses' Association and the Assistant Mistresses almost as one woman in favour also. From this state of affairs one can judge where the shoe pinches most, but there is no

[1] From the presidential address, entitled "Education: The Next Steps," delivered before Section L (Educational Science) of the British Association at Glasgow on Sept. 7.

doubt that it does pinch, and anyone who remembers the figures which I have just quoted will quite readily understand why. There are more boys and girls taking the full secondary course to-day than are either fit for it or fitted by it. The malcontents are quite right in the criticisms which they level against the system and its results, but they are in my opinion wrong as to the nature of the cure and the method by which they would bring it about.

The standard of secondary education in England is high, and is something of which we have a right to be proud. Its methods and objects are the fruit of long experience and of the efforts of several generations. The boy or girl who has taken a school certificate before the age of sixteen, followed an advanced course, or specialisation in a sixth form, to the age of 18 +, has reached a level attained in few educational systems other than our own. I question, indeed, whether any country is producing boys and girls of as high a level of intellectual excellence and training as those hundreds who go up every year to compete for scholarships and places at Oxford and Cambridge. I believe this to be true of the boys, and it is certainly true of the girls. This system is now built on the general education of the school certificate and the specialised education of the higher certificate, and I hold that it should stand unimpaired, and not be tampered with; for it is far easier to relax a standard than ever to recover it. To say that every boy and girl who goes to a secondary school for four years should be awarded the same certificate, whatever subjects they may have studied and offered, is to say that things which are not equal to one another are equal to the same thing; it is to say that the boy who has been successful in English, history, geography, Latin, French, mathematics, and science is *prima facie* the same article as the boy who has been successful in English, general elementary science, drawing, handicraft, and shorthand, or the girl who has offered English, botany, music, drawing, and needlework.

I am not representing either course as better than the other; one may be right for *A* and the other for *B*. I hold no brief to argue that the high-brow is better than the low-brow, or the blue stocking than the flesh-coloured stocking. All that I maintain is that they are palpably not the same, that it is illogical therefore to call them the same, and that nothing but confusion will result from calling them the same. It may be democratic and in accordance with the spirit of the age to hold that we are all the same as one another, and ought therefore to be labelled with the same labels; but no man who has taught a class for one term can really hold that Nature gives any warrant to such nonsense. Surely the logical course is to award two kinds of certificate, one which shall fulfil the academic conditions and maintain unlowered the existing system which causes no difficulty to the boy or girl of average academic ability, and the other which shall be a proof that the boy or girl has taken at school that course of education which in the particular case was the most fitted.

I would therefore have in any secondary school these two types definitely recognised to be different, not superior or inferior, the one to the other, but different. It would be recognised at the school certificate stage by one type sitting for the school certificate awarded as it now is, and the other for a general certificate which shall show that they have made good use of a good and sensible type of education. If they stay at school, one type will continue to go on to the higher certificate, again organised as it now is, and the other to a second certificate, which shall again test the subjects of a quite unspecialised education, designed to meet the individual need in each case. There will then be a good deal of variety inside secondary education, and when the central schools become more numerous and more organised, and the modern schools come into existence in increasing quantity, there will be a good deal of variety outside the old secondary schools as well.

Even so my discussion of the problem of the right curriculum for the higher forms of the secondary school is not complete. In saying that the standard should remain unimpaired, and not be tampered with, I have in mind the work of the best boys and girls. But many more than the best go on to the universities, and it is right that they should do so; I am not convinced that any of these should attempt specialised study before they enter the classes of the university. On one hand, the colleges of Oxford and Cambridge, through their open scholarship examinations, enforce on the schools the attempt to reach a very high standard along narrow lines; some universities, by allowing their intermediate examinations to be taken through the higher certificate, confuse the courses proper to themselves and to the schools; some universities admit their students too early; the higher certificate courses themselves often involve specialisation built on a very slender foundation of general knowledge. On the other hand, many professors and university teachers are loud in their condemnation of the state in which their pupils come to them, with minds ill-balanced and ill-furnished. I submit that this region of the last two years of school is insufficiently explored, and the nature of the work that should be done by the average student not thought out. I submit further that it is a matter which might well engage the attention of all the universities of the country in conference. They have perhaps no common mind, but I do not know that they have attempted to arrive at one: they have never clearly stated what they want; they have never faced the fact that through their scholarships they make extreme specialisation necessary, and through their professors complain of the result. I regard the matter as urgent, for as chairman of the Secondary Schools Examination Council, I know that the curriculum and the examinations proper to this later period of school life stand in great need of definition, and that in proceeding to the work, which cannot long be deferred, we have no clear guidance from the universities as to what they really want.

However, it is not only in the secondary schools that some thinking needs to be done about the

requirements of the immediate future; there is also some advance that needs to be made, after due thought, in that very complicated field which is known as technical and further education. Technical education is a field which has been developed all by itself, and in isolation from almost everything else. Each part has grown to meet a need, and usually a local need. It is cut off from the elementary education which precedes it, for elementary and technical education have been controlled by different departments of the Board of Education, and it is cut off from the university education, which in the case of the best students ought to follow. There is frequently a gap of one, two, or even more years between the end of the elementary course and the beginning of technical instruction, and that instruction is frequently sterilised by the fact that students have come to it tired, late in the evening, and in the centre of cities. Finally, there is need of much fuller contact, of more mutual knowledge and sympathy, not only between technical education and industry, but also between all forms of industry and commerce and all forms of education. There ought to be a full inquiry into this difficult and complicated problem; educationists ought to know and consider more thoroughly what is wanted, and employers ought to take much more trouble to find out what is being done.

There is a large question of very general interest which I can state, though I do not know that I can supply an answer. What is the proper part which formal and external examination should play in our educational courses? Examinations at the present time play a very large part. In a great many places there is competition and examination for scholarships and for free places at the secondary schools; some four years later there follows the school certificate, theoretically for all. One or two years later follows the higher certificate examination, and then there are for some all the university and professional examinations in prospect. Entrance to the public schools is obtained by an examination known as the Common Entrance Examination, which is said in some cases to be competitive, but in all cases involves the reaching by the candidate of a certain definite standard. Competitive examination admits to the Army, Navy, and the Civil Service. The system is so thorough and so universal that the victim, if that is the right word, may never be out of the shadow of an examination from eleven years old to twenty-three, or even later. It is argued, first, that this gives almost inevitably a totally wrong view of knowledge, and makes a boy or a girl from school days on feel that his or her object is not to study a subject, but to acquire the capacity to answer on paper examination questions about it, and that therefore, once examinations are over, he or she learns no more. It is argued, secondly, that the teacher's freedom is destroyed, since he has to teach his subject not in the best way, but in the way which will pay best in the examination, and that the more inspiring, original, and fresh he is in presentment, the less he is likely to succeed on a mechanical system. It is alleged, thirdly, that the system is really unsuccessful, that it picks out for honour those who have the examination faculty and can write fast and to the point, but that, judging by what happens in after-life, it does not really pick the best men and women, and those who will go furthest in their study.

There is a certain amount of truth, but a good deal of unreasonableness and lack of practical common sense, in all this attack which is so frequently made to-day. My own profession, the schoolmasters, are not consistent, though the schoolmistresses dispute the palm with them, for they insist on a certificate to mark the successful completion of all their courses, and do not rest until all the subjects which they teach have been brought, for example, within the ambit of the school certificate. The subjects which of all others ought to be the most free, and are in my opinion in their own interests least examinable—music and art—are, I suppose, the means for awarding more certificates by examination than any other, and the blame for this I lay largely at the door of my professional brothers and sisters. It is not, I think, seriously true that teachers are cramped by the examinations; on the whole, examinations follow the school curricula, and do not control them; the teachers, moreover, are well represented on the examining authorities, and can make their voices heard. It is not possible to say whether a boy or girl knows a subject save by asking questions; these must be the same for all, answered under the same conditions in the same time, and that makes a written examination necessary. No one suggests that examinations are more than they are, a very human and sometimes fallible means of finding out whether a candidate knows what he ought to know, and no one in his senses claims that they pick out the person who will be ultimately the most successful. What is true is that in early years they tend to dull the edge of the desire for true knowledge, and that throughout school life there are plenty who are quite incapable of showing on paper what they have in their head; they are not fools, though they may be written down as such, but they are bad examinees. Moreover, in any system of examination which is more or less universal—as is the case with the school certificate—we have to think of the dull and of the slow developers, who suffer badly when they are crammed and forced to an unnatural level.

I believe, therefore, though the time is not yet, that the right course will be to abolish all external examination for the average boy and girl, though leaving it as the avenue to the universities and the professions. In the case of the average boy and girl, the properly inspected and efficient school will issue its own certificate that *A* or *B* has attended for four or six years as the case may be, and has reached a satisfactory level of performance. The power to make such an award implies a high standard of professional honour, and perhaps a higher level of efficiency than yet exists, but it would enable the schools to teach a pupil what he could learn, to teach him in the right way, and not drive him in the wrong way to a wrong standard.

Obituary.

Dr. John Rennie.

By the sudden death of Dr. John Rennie, of the University of Aberdeen, on Aug. 30, zoology has lost an investigator of high quality. Educated at Aberdeen under the late Prof. Alleyne Nicholson and others, Dr. John Rennie became in 1899 chief assistant to Prof. J. Arthur Thomson, and he so continued until 1917, when he was promoted to be lecturer in parasitology and experimental zoology, and was put at the head of a laboratory of his own. He had previously become lecturer in agricultural zoology in the College of Agriculture, and he was also in charge of the nature-study classes at the Training College.

Dr. Rennie had great gifts as a teacher, for he was singularly clear in his lecturing, thorough, deliberate in manner, and of unruffled patience. He had a discernment of profitable problems to work at, for one of his early successes was an account of the minute structure of the Islands of Langerhans, which he had found in sharply defined form in some teleostean fishes. Along with a physician, he began trying the effect of extract of these Islands on diabetic patients, a distant hint of insulin treatment. For various reasons, especially the difficulty of steady supply, this experiment was not carried far.

In connexion with his agricultural work, Dr. Rennie became much interested in entomology, and this led him, along with Mr. John Anderson, lecturer in bee-keeping in the College of Agriculture, to attack the problem of Isle-of-Wight disease in hive-bees. Thanks to the generosity of Mr. A. H. E. Wood, of Glassel, one of the leading apiarists in Scotland, Dr. Rennie was able to secure the assistance of Dr. Bruce White, who worked in Prof. Shennan's Pathological Laboratory, and of Miss Elsie Harvey, who worked in his own. It was a case of team-work, for it was Dr. Bruce White who first recognised the significance of the tracheal mite, *Acarapis woodi*, and it was Dr. Rennie who demonstrated convincingly the causal relation between the mite and the disease. At this time he was working far too hard, examining thousands of bees, week after week, and he probably weakened his never robust, though carefully husbanded, health. In the last two or three years Dr. Rennie was working at the curative treatment of Isle-of-Wight disease and had made some important steps.

Dr. Rennie had many friends, won to him by his quiet, unassuming ways, his sincerity and reliability, and his unfailing generosity to other workers. His researches were marked by their high standard of precision and by their cautious thoroughness. Dr. Rennie was about sixty-three years of age; he is survived by a widow, three daughters, and a son. A month or so ago his eldest daughter was married to Dr. Norman Wright, of the West of Scotland Agricultural College.

We regret to announce the following deaths:

Dr. Jean Brèthes, entomologist at the National Museum of Natural History, Buenos Aires, on July 2.

Mr. Charles Curtis, superintendent from 1884 until 1903 of the Botanic Gardens at Penang, on Aug. 16, aged seventy-five years.

Prof. E. C. Grey, formerly professor of chemistry in the University of Cairo, who carried out investigations for the League of Nations on the food problems of Japan and was known for his work on the chemistry of fermentation, on Aug. 10.

Prof. Wilhelm Wien, professor of experimental physics in the University of Munich, editor of *Annalen der Physik* and of "Handbuch der Experimentalphysik," who was a distinguished worker on the nature of cathode and canal rays, aged sixty-four years.

News and Views.

The brochure entitled "Broadcast English I. Recommendations to announcers regarding certain words of doubtful pronunciation," which was recently published by the British Broadcasting Corporation, is a scholarly production, and one that should appeal to a wider audience than that for which it is primarily intended. Though the pen is the able one of Mr. A. Lloyd James, of the School of Oriental Studies, the voice is that of the expert committee, which includes, among others, the Poet Laureate and Mr. G. Bernard Shaw, and was appointed by the Corporation in 1926. Speech, it is pointed out, is governed by local convention and public taste, and although most people think there are right and wrong ways of speaking, these adjectives are only applicable where the different considerations of propriety all lead to the same conclusion. "The higher a community climbs in the social scale, the greater is the uniformity in its speech." There is no standard pronunciation of English, so there cannot be one and only one right way of pronunciation. Our language is rich in alternative pronunciations of equal authority, and the task of the B.B.C. has been that of deciding between them. The special difficulties of the task originate in the discrepancy between sound and written symbol, the presence of many foreign words, the relationship between the value of a symbol in the modern language and the value it had in a classical tongue, and the absence of any principle to govern the incidence of stress.

The task of the Committee, it will be admitted, was not easy, and if one does not agree with all the findings—unanimity was not expected—the main principles of selection, as set out in the booklet, will probably meet with little criticism. The recommendations, having the praiseworthy object of providing some measure of uniformity in the pronunciation of English, will be welcomed by scientific men, who will be particularly interested in those which relate to words, often troublesome to pronounce, that are frequently used by them. Among such words are the following (a doubled vowel letter indicates a long vowel sound, and a double-consonant letter

indicates that the previous vowel is short): Acoustic — acóostic, basalt — bássolt, ceramic — serámmic, data — dáyta, evolution — éev-, fetish — féetish, gyratory — jýratory, iodine — éye-o-dyne, laboratory — stress on second syllable, metallurgy — métalurjy, nomenclature — nōménclature, patent — páytent, except in 'Letters Patent' and 'Patent Office,' which have páttent, ration — rhymes with fashion, reverberatory — chief stress on second syllable, secondary stress on fourth syllable, rotatory — rōtáytory, zoological — zō-ŏlój-ical, except in 'Zoological Gardens,' where the pronunciation is zoo-lój-ical. Although most of these recommendations are in accord with current practice, we believe the chemists will object to 'éye-o-dyne,' the metallurgists to the secondary stress in 'reverberatory,' and perhaps both to 'labóratory.'

Two of the centenaries of greatest scientific interest which occur next year will be those of the deaths of Thomas Young and Sir Humphry Davy, both of whom died in May 1929, the former in London and the latter at Geneva. The birth of Young took place in 1773, that of Davy in 1778, the centenaries of which, in 1873 and 1878, however, the scientific world allowed to pass without proper recognition. In the case of Davy we commented in our columns at the time on this lack of recognition, adding, "We leave it to a foreign nation to honour the memory of one of our greatest explorers and to a petty provincial town to commemorate the birth of one of our greatest chemists." It is with interest, therefore, we learn that inquiries are already being made as to what steps are being taken to pay due homage to Young, who was the first to explain the phenomenon of the interference of light, who described the optometer, the precursor of the ophthalmoscope, who first gave the word 'energy' its present scientific significance, who provided engineers with 'Young's modulus,' and who deciphered the Rosetta Stone. Of Davy it is only necessary now to recall his experiments with nitrous oxide, his isolation of potassium and sodium, his determination of the elementary character of chlorine, and his invention of the safety lamp.

Both Young and Davy came from the 'West Country,' —the former from Somerset, the latter from Cornwall —both became distinguished fellows of the Royal Society, both were connected with the Royal Institution, both were foreign associates of the Paris Academy of Sciences, and both are commemorated in Westminster Abbey. If Young surpassed Davy in the depth and range of his scientific inquiries and his immense learning, Davy by his manipulative skill, his command of language, and his poetic imagination secured a popularity denied his great contemporary. Both, however, had a world-wide reputation, and while Davy's work is commemorated by the Davy Medal of the Royal Society, Young's is recognised by "The Thomas Young Oration" of the Optical Society. It is to those societies that the scientific world will look for the initiation of the proper celebration of the centenaries of these eminent men of science.

In *Science* for July 27, is a report of the address by Prof. L. C. Newell of Boston University on "Count Rumford—Scientist and Philanthropist," given at Woburn, Mass., on Mar. 26, the 175th anniversary of Rumford's birth. Rumford is known as the founder of the Rumford Medals of the Royal Society and of the American Academy of Arts and Sciences of Boston, and also of the Royal Institution; his whole career was permeated by the desire to apply knowledge to practical ends, and Prof. Newell speaks of him as "the first man to advocate sensible home economies and rational dietetics." Born plain Benjamin Thompson, it was George III. who knighted him, and the Elector of Bavaria who made him a Count of the Holy Roman Empire. Rumford's versatility can be measured by no ordinary standard, and it was Gibbon who dubbed him "Mr. Secretary—Colonel—Admiral—philosopher" Thompson. Of the Royal Institution, Prof. Newell remarks that Rumford's "conception was a perfect expression of himself. It combined science and philanthropy; its twofold purpose was to seek the truth and make it useful. But, like many institutions established on broad foundations to meet the specific needs of a period, it was not developed as the founder planned. The practical and the useful as seen by Count Rumford were soon overshadowed by the scientific. Stoves, kitchens, and contemporary mechanical contrivances were gradually set aside and quietly forgotten. Models were replaced by men—in succession: Davy, Faraday, Young, Tyndall, Rayleigh, Dewar, Bragg, and many others. These men have carried out Count Rumford's aim—not his special plans, but his aim as a scientist and philanthropist—discovery of truth which helps mankind."

The *Journal of the Society for the Preservation of the Fauna of the Empire* is an excellent means of propaganda for a very worthy object. Instead of the formal reports usually contained in such a publication, the recent issue of the *Journal* has many short and readable articles on various aspects of the fauna of the British Empire and the methods adopted for its preservation. Extracts are given from the informative reports of the game wardens of the Transvaal Game Reserve, of Kenya Colony, and of the Uganda Protectorate, and these indicate that the regulated slaughter of game animals by licence may be a profitable business as well as a means of conserving the stock. Col. J. Stevenson Hamilton writes upon the bush pig, and an article on game and tse-tse fly in Nyasaland states that the slaughter of big game only has not succeeded, and cannot succeed, in reducing the numbers of tse-tse, the indication being that one result is to cause the fly to range farther and become more prone to attack man. The game warden of Kenya praises the introduction, with a view to future liberation, of Scottish red deer to the hills of Kipipara, and proposes to turn down Indian blackbuck in the Colony. He refers to objectors to this policy as taking 'the parochial view.' On the contrary, the objection to the setting free of such importations is the scientific view, and the warden's comparison of the stocking of a wild country with foreign animals to the cultivation of exotic plants in a garden is beside the point. It is sufficient to point out here that the turning loose of

aliens has had in other lands a very direct and injurious effect upon the native faunas into which they were thrust, and, although the Society specifically disclaims responsibility for opinions expressed in articles in its *Journal*, we trust that this is no part of its policy and that it will use its influence against such introductions unless they be made to meet some real need of the district.

The collection of chemical memorabilia assembled by the late Dr. Edgar Fahs Smith has been presented to the University of Pennsylvania by his widow; it will be preserved intact in its present setting in the Harrison Chemical Laboratory of the University, and will be known as "The Edgar Fahs Smith Memorial Collection in Historical Chemistry." The University is making special arrangements by which it will continue to be accessible to visitors and students of the history of chemistry, many of whom during Dr. Smith's lifetime had frequent recourse to it for study and research work. Dr. Smith, who died on May 3 this year, had served as emeritus professor of chemistry at the University after resigning the provostship in 1920. The collection comprises three main divisions. The first contains about 500 autographed letters and manuscripts of eminent chemists of all nationalities; the second is made up of approximately 1000 portrait prints and engravings of prominent chemists from the days of the alchemists to the present time, and the third consists of nearly 1000 books on alchemy and chemistry. In addition, there is an unusually rare collection of books and manuscripts relating to the history of the University of Pennsylvania and the lives of outstanding alumni and members of the faculty. Dr. Smith had long been interested in the life and works of Priestley, and in 1926 had deposited in the Priestley Museum at Northumberland, Pa., a collection of Priestleyana which was said to be the largest of its kind and included Priestley's balance and the original manuscript of "Priestley's Memoirs."

A joint expedition of the Percy Sladen Memorial Fund and the American School of Prehistoric Research (of which Prof. G. G. MacCurdy is the Director), is leaving England towards the end of this month to carry out a prehistoric survey in southern Kurdistan. The party will consist of Miss D. A. E. Garrod, Mrs. C. A. Baynes, Mr. F. Turville-Petre, and Mr. Robert Franks. The special object of the expedition is to make soundings in the numerous unexplored caves which lie near the Iraqi-Persian frontier in the neighbourhood of Sulaimanieh. It is hoped that this district, which offers a completely new field to the prehistorian, may yield important traces of palæolithic man. The prehistoric survey carried out this year for the Field Museum by Mr. Henry Field has shown that the North Arabian desert, hitherto regarded as a geographical barrier, was, on the contrary, a highway for the palæolithic tribes, and the presence of palæolithic man in north-eastern Iraq was demonstrated, in the course of a short preliminary survey which Miss Garrod made last February, by the finding of Mousterian implements in gravel-spreads near Kirkuk. These discoveries point to the caves of Kurdistan as a promising field for prehistoric work, and this fact is fully recognised by the Department of Antiquities at Baghdad, which is assisting the expedition in every possible way.

An important new process for the production of wood pulp is now being developed. An ideal method undoubtedly is to boil the raw wood under pressure with caustic soda solution, so that the lignocelluloses are dissolved and almost pure cellulose left as a pulp, ready for paper making, artificial silk manufacture, and so on. But hitherto the residual liquor, known as 'black lye,' has been a waste product. Dr. Erik L. Rinman, a Swedish chemist, aided by an English engineer, has now found a method of utilising this 'black lye.' The latter is evaporated down *in vacuo* to a treacle-like product, which is then carbonised at not above 750° F. in retorts, giving a whole series of valuable products, including methyl alcohol, acetone, methylethylketone, acetone oil, light tar oils, heavy tar oils, and turpentine. The residue from the retorts, known as 'soda coal,' consists essentially of sodium carbonate and free carbon, and is burnt on a special new design of mechanical stoker, which consumes more than 97 per cent of the carbon, the heat being used for steam generation, while the sodium carbonate is extracted with water and reconverted into caustic soda. A large plant on these lines is now operating under the superintendence of Dr. Rinman at Regensburg in Bavaria, with water from the Danube, turning out 600 tons of pulp a month, while extensions are being carried out to give 2000 tons a month. A British financial group is now to develop the process throughout the world in association with the original company, Aktiebolaget Cellulosa of Stockholm. A production of 1000 tons of 'Kraft' pulp is stated to result also in 25 tons of methyl alcohol, 18 tons acetone, 18 tons methylethylketone, 12 tons acetone oil, 8 tons light oil, and 50 tons heavy oils.

The seventh session of the International Commission on Illumination is being held at Saranac Inn, N.Y., on Sept. 22–28, under the presidency of Mr. Clifford C. Paterson, Director of the Research Laboratories of the General Electric Company, Ltd., London. A tour of the principal cities of the eastern United States, organised by the Illuminating Engineering Society of New York (Sept. 7–17) and also the annual Convention of the Society at Toronto (Sept. 17–20), preceded the meeting. The British delegation is particularly strong and consists of fourteen representatives of the technical, professional, and commercial organisations interested in illumination. Twelve papers are being presented on behalf of the National Illumination Committee of Great Britain, which is responsible for the British representation at the meeting. In addition, the British National Committee, which has the secretariat responsibility for the subjects of coloured glasses for signal purposes and of daylight illumination, is presenting a report on each in collaboration with the various experts nominated by the countries which are members of the Commission. The programme includes fifty-two papers covering a wide range of subjects of importance to

illuminating engineers, architects, medical officers, and students of pure science. Delegates from ten different countries are attending, and there is every prospect of a very successful meeting of the Commission under its first British president, who, together with its secretary, Dr. J. W. T. Walsh, are to be congratulated on the splendid support received from all the countries participating in the work of the Commission.

SOME time ago we mentioned in these columns the efforts of the Astronomical Society of the Pacific to cultivate public interest in astronomy by the issue of leaflets containing popularly-written and authoritative information on the latest views and discoveries of workers in this branch of science. We are pleased to learn that this practice is followed also by the New Zealand Astronomical Society, and a set of pamphlets which we have recently received testifies to the valuable work which that Society is doing in this direction. The pamphlets are mainly reprints of articles and notes on astronomical matters which have been published periodically in various New Zealand journals. They deal with such matters as the aspect of the heavens in various months of the year (in connexion with which, opportunity is taken of imparting interesting information concerning the various objects visible), freely interspersed with poems and 'reveries' inspired by the contemplation of celestial objects. The New Zealand press evidently makes ample provision for those of its readers who are interested in astronomy, and we congratulate the Society on the efforts it is making in preparing the newspaper articles and in extending their usefulness by the issue of reprints.

A HURRICANE which has caused much loss of life and damage to property passed over the West Indies a few days ago. According to the New York correspondent of the *Times*, the wind at San Juan on Sept. 13 blew for six hours at 100 miles an hour, occasionally rising to 150 miles an hour; the anemometer at the weather bureau registered 132 miles an hour before it was carried away. The storm was travelling west-north-westwards at about 300 miles a day. It reached the Florida coast between Miami and Jupiter Inlet on Sept. 16, and a wind velocity of 135 miles an hour was reported at Palm Beach. The storm traversed a belt about 80 miles wide, and considerable damage to houses, communications, and particularly to crops, is reported. The greatest loss of life seems to have been at Porto Rico, where the deaths are estimated to exceed a thousand. In NATURE of Oct. 9, 1926 (p. 524), Mr. E. V. Newnham, of the Meteorological Office, discussed the incidence of tropical cyclones, showing that they may be expected at this time of year, and reference to this article will show that the present hurricane is following the usual course of such storms.

READERS of NATURE will remember that about a year ago a discussion arose out of a review of Prof. C. Spearman's work entitled "The Abilities of Man: their Nature and Measurement" (NATURE, Aug. 6, p. 181; Nov. 12, p. 690). The subject has been carried further in two recent papers, one by Prof. Karl Pearson and Miss Moul in *Biometrika* (Dec. 1927) and the other by Prof. Spearman in the *British Journal of Psychology* (vol. 19), which those interested in the discussion are invited to consult.

A STARLING picked up in Leicester, ringed with the inscription "Museum, Göteborg, Sweden, No. 3436," has led the Leicester Museum to prepare a case illustrating long-distance flight and methods of ringing. A similar exhibit illustrating bird-migration has been installed at the Castle Museum, Norwich, where a committee is preparing a scheme for the adequate display of the fine collection of British birds in accordance with modern museum methods. Among accessions mentioned in the recent Report of the Norwich Museums Committee is a set of Eskimo weapons, garments, and domestic utensils, collected in Baffin's Land by the Rev. J. W. Bilby, who resided there for twenty-five years.

NOTICE has been issued of the forthcoming second International Conference (and Exhibition) on Light and Heat in Medicine, Surgery, and Public Health. This will be held at the University of London on Oct. 29–Nov. 1. Sessions will be held in the afternoon and evening of the first three days, and in the afternoon only of the last day. Several continental authorities are expected to take part in the discussions, among whom may be mentioned Prof. Jessinek, Dr. Nagelschmidt, and Dr. Harkamp. An exhibition of apparatus will be held in the Great Hall and the East Gallery of the University adjoining the Conference Hall; it will be open from 2.30 to 9.30 P.M. each day, closing at 6 P.M. on Nov. 1. The chair will be taken by Lieut.-Col. F. E. Fremantle, M.P., chairman of the Parliamentary Medical Committee. Those wishing to take part in the discussions should send their names to the Conference Department, *British Journal of Actinotherapy*, 17 Featherstone Buildings, London, W.C.1.

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include four superintendents to the Agricultural Department, Nigeria, namely, Mr. O. J. Voelcker, Mr. G. N. K. Turnbull, Mr. J. H. Palmer, and Mr. E. W. Leach. Mr. E. S. Morgan is appointed a produce inspector to the same Department. A forest surveyor, Mr. J. Brushwood, and a veterinary officer, Mr. W. G. McKay, have been appointed to Kenya Colony. Mr. G. Cowan has been appointed superintendent to the Gold Coast Agricultural Department; Mr. H. Bruins-Lich, horticulturist, St. Helena; Mr. H. P. Smart, agricultural officer, British Honduras; Mr. E. E. Martyn, botanist and mycologist, British Guiana. Six of these appointments are of scholars selected for two years training in Great Britain and at the Imperial College of Tropical Agriculture, Trinidad, under the Colonial Office Agricultural Scholarship Scheme, whose course finished last June. Amongst the transfers notified is that of Mr. C. W. J. Line from the Gambia to the Gold Coast Agricultural Department.

THE Committee on photochemistry of the National Research Council of the United States has recently

issued its first report. This consists of a collection of six papers which appeared in the *Journal of Physical Chemistry*, April 1928, together with a short introduction by H. S. Taylor. The subject is considered from both the experimental and theoretical points of view, and the authors are: H. S. Taylor, W. D. Bancroft, G. S. Forbes, H. G. De Laszlo, S. C. Lind, and L. A. Turner.

WE have received a copy of Messrs. Oertling's new catalogue of British chemical balances and weights, in which a brief outline of the history of this well-known firm from its foundation in London in 1849 to the present day is sketched. Precision instruments suitable for the finest work are now being made extensively in London by the firm, which claims to be employing only British capital and labour. Recent developments have necessitated the acquisition of a new factory, and the showrooms have been removed to 65 Holborn Viaduct, London, E.C.1, where the latest models may be inspected. The list includes balances suitable for use in schools and colleges, and also more elaborate instruments for research laboratories and factories. Special features are the precision torsion-balance, designed for the rapid weighing of very light objects up to 500 milligrams in weight with a sensitivity of 1 milligram, a micro-chemical balance with a concave cylindrical reflector for magnifying the fine divisions on the index, a flour-moisture tester and the 'chainomatic' balance, which has a capacity of 200 grams and a sensitivity of 0·1 milligram, although riders and fractional weights below 0·1 gram are not required. The prices compare favourably with those of continental makes.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A reader in physics in the University of Dacca (East Bengal, India)—The Registrar, University of Dacca, East Bengal (Sept. 30). A male senior lecturer in education at the Rhodes University College, Grahamstown—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Sept. 30). An assistant lecturer in education at the University College of Swansea—The Registrar, University College, Swansea (Oct. 1). A lecturer in dental prothesis and orthodontics in the Dental School, Cairo—The Dean of the Faculty of Medicine, Kasr-el-Ainy, Cairo (Oct. 3). A physicist with electrical engineering experience, under the directorate of radiological research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An advisory entomologist in the West Midland Province of Shropshire, Staffordshire, and Warwickshire, at the Harper Adams Agricultural College, Newport, Shropshire—The Principal, Harper Adams Agricultural College, Newport, Shropshire. A temporary architectural and civil engineering assistant at H.M. Dockyard, Rosyth—The Superintending Civil Engineer, H.M. Dockyard, Rosyth. A lecturer in zoology and botany at the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham.

Our Astronomical Column.

CONJUNCTION OF URANUS AND A STAR.—On the night of Sept. 23, Uranus will make a very near approach to a small star of the sixth magnitude in the constellation Pisces. The two objects will appear in a telescope as a double star of faint and nearly equal magnitude. It will be interesting to find if they can be distinctly seen and separated by the unaided eye. An opera or field glass will show them well, and will exhibit their changes of position on succeeding nights due to the motion of the planet. The latter will pass the star on its southern side, its motion being from east-north-east to west-south-west.

The objects may be readily identified though they occupy a position in a decidedly barren region of the sky. If a line is drawn southwards from Sirrah to Algenib, the two bright stars forming the eastern side of the "Great Square of Pegasus," at about the same distance as that separating the two stars, the planet Uranus and the star 44 Piscium will be found a little to the south-east of the end of this line. The objects will be just visible to the naked eye on a dark moonless night, but whether they may be individually discerned is a little uncertain, as a good deal must depend upon the observer's vision and the state of the atmosphere. The gibbous moon will set on the night following Sept. 23 at midnight.

A RECENT LARGE SUNSPOT.—A large group of sunspots which showed considerable changes from day to day has recently been under observation. The group, which was of the stream type, did not develop in the usual manner, and on Sept. 11 several irregularly shaped spots composing the train became nearly linked up with the leader, thus almost completing one big composite spot. As indicated by changes directly observable within some hours, the group was active spectroscopically. Mr. Newbegin, using a spectroscope of the Littrow type which he has added to his private observatory at Worthing, noted Doppler displacements of the *C*-line of hydrogen on Sept. 11, and later a bright reversal of this line was seen. A magnetic disturbance might reasonably have been expected about Sept. 13, but although the Greenwich magnetograph traces were somewhat disturbed for a few days about this time, no pronounced disturbance was registered. This group of spots, together with another large one seen six weeks ago, continues the list of naked-eye spots given in NATURE of July 28 (p. 142).

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
6	July 27–Aug. 6	July 31·8	14° N.	1/1000
7	Sept. 6–18	Sept. 12·7	14° N.	1/1000

Areas are expressed as proportion of sun's hemisphere covered.

METEOR OF SEPT. 9.—Mr. W. F. Denning, 44 Egerton Road, Bristol, informs us that a bright meteor was observed by Mr. R. Kingman at Bristol on Sept. 9, at $8^h\ 35^m$ G.M.T. It passed almost vertically through Ophiuchus along a path of about 27° from $270° + 24°$ to $261° - 2°$. The meteor was about as bright as Venus, and it gave a flash at the end which illuminated the southern sky. The motion was swift and the flight of the object seemed directed from a radiant at $290° + 52°$ in Cygnus, which is well known as supplying many meteors in August and September. A duplicate observation would be valuable and enable the radiant to be ascertained with certainty, as well as the height and velocity of the object.

Research Items.

RELIGION IN SZECHUAN, CHINA.—No. 1 of vol. 80 of the *Smithsonian Miscellaneous Collections* is a study of Chinese religion in Szechuan Province by Mr. David C. Graham, who points out that this area provides an excellent ground for the study not only of the religious beliefs of the Chinese themselves, but also of those of the aborigines. In the family, which is the social unit, and not the individual, the ancestors are a part, and the most honoured part. The ceremonies of their cult can only be performed by the eldest son. Hence, not only are sons desired, but also every means taken to protect them from harm. The conception of a multiple soul makes it possible to commemorate the dead person at the tablet and the grave, while the soul, or one part of it, may also reside in the underworld. At death every effort is made to entice the soul to return and take up its abode in the ancestral tablet. In the popular religion the conception of *mana* is the primary key to understanding. Demons, the spirits of the dead who for some reason are not at peace, play a large part in the lives of the people and are the cause of all diseases and other calamities. Both gods and charms protect from their influence. The element of luck creates and maintains a belief in a mysterious potency, producing belief in lucky and unlucky days and being responsible for a number of superstitious practices. The organised religion is so arranged as to arouse the feeling of awe and loyalty by its large temples situated on hills, and the imposing character of the great deities with their robes and their retinues of priests and their festivals. This feeling reflects the attitude towards and the practices connected with their one-time temporal rulers. Notwithstanding the spread of democratic ideas, to which anything connected with royalty is abhorrent, this aspect of religion remains unchanged.

THE HAVASUPAI.—In a detailed study of the Havasupai, a small and obscure group of Yuman-speaking Indians living near the Grand Canyon in north central Arizona (*Anthrop. Papers, American Museum Nat. Hist.*, vol. 24, pt. 3), Mr. Leslie Spier points out that much of their old life is still open to observation, social life, religion, art, and—only to a less extent—material culture being practically intact. Yet they have been little studied. They are closely related in speech to the neighbouring Walapai, with whom they intermarry. Members of each tribe commonly live with the other. In 1919 they numbered 177; the limitations of the cultivable area make it improbable that at any time did they number more than three hundred. They are seasonal migrants. In the spring and summer they live in villages along the canyon, cultivating the fields; in winter they live on the plateau in the cedar thickets, existing on the corn saved from the harvest, and seeds and nuts, as well as by hunting. An abundant harvest is marked by wide-spread invitations to Walapai, Hopi, and Navajo to the harvest feast and dance. Marriage is normally monogamous and forbidden between blood-kin. This tie, however, is not recognised beyond the grandparents. The basis of their life is the family; there are no indications of the existence of clans or gentes at any time. The unit family lies within a larger group of family relations—those of the husband's or wife's parents; a grouping based upon the inheritance of land and a temporary matrilocal residence. The larger groupings have been intensified by a shortage of competent marriageable women. Hence men and children have often been compelled to rely upon the services of a female relative. There are six chiefs, of whom one is recognised as head. Men may become chiefs through inheritance, prestige, or ability. The chieftainship, however, is emphatically not a position, but the embodiment of certain functions. A woman may not become a chief.

THE POISON OF THE STONE FISH.—Various opinions have been expressed as to the situation of the poison glands of the spines of the stone fish (*Synanceja horrida*). Dr. J. V. Duhig and Gwen Jones have summarised the literature, investigated the problem, and carried out experiments on the effects of the poison (*Mem. Queensland Mus.*, vol. 9, part 2, 1928). The poison is secreted in sacs upon the dorsal spine. Venom from a single fish was emulsified in normal saline solution so as to give a dilution of 1 in 10. Of this emulsion 0·1 c.c. injected beneath the skin of a guinea-pig, produced a toxic action on the voluntary and involuntary muscles, so that in the course of an hour respirations became slow and shallow, and all the limbs became paralysed. After 8½ hours the most marked of the symptoms had passed off. As well as producing these, probably neurotoxic reactions, the poison has a lytic action on the red blood cells. Recovery from the gross effects of the venom conveyed some degree of active immunity. The authors give full clinical notes on a case where a man trod on a stone fish, the spine of which penetrated the sole of his foot. They are inclined to attribute a marked respiratory failure of the patient a fortnight later to the effects of the venom.

THE FLOCK PIGEON OF AUSTRALIA.—Australian ornithologists are exercised by the rapid disappearance of the flock pigeon (*Histriophaps histrionica*), the history of which threatens to repeat that of the American passenger pigeon. During the nineteenth century many observers recorded enormous flocks of these birds even up to two miles in length, and so late as 1901 they were seen in Western Australia in "countless myriads." Since then their numbers have unaccountably dwindled. They are unknown throughout the country where the two miles flock was seen in the 'sixties of last century, and extensive inquiries made by F. L. Berney (*Mem. Queensland Mus.*, vol. 9, part 2; 1928) show that in most places where they were once common they are either absent or are represented by but a few individuals. From Queensland only comes a recent record (February 1928) of considerable numbers, a flock of four or five hundred having appeared in the Flinders River basin. There has undoubtedly been an extraordinary decrease during the past twenty-five years, and this cannot be attributed to the spread of farming or to actual destruction by man. But the flock pigeon, unlike the passenger pigeon, is a ground nesting and ground feeding bird, and we suggest that the cause of the decrease may be looked for in the increase of ground vermin, particularly the small carnivores which have been introduced by earlier settlers. In other lands, and especially in islands, ground nesters have been the first to disappear under the pressure of animals thus introduced.

AMERICAN ROTIFERS.—In continuing their work on American rotifers, H. K. Harring and F. J. Myers ("The Rotifer Fauna of Wisconsin. IV. The Dicranophorinæ." *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, vol. 23, January 1928) occupy themselves with the large family Notommatidæ. The family is divided into two sub-families, the Notommatinæ, which are plant and detritus feeders, and the Dicranophorinæ, which are carnivorous. So large is the group that the authors state

that they can visit old favourite collecting grounds regularly and still bring back new species. The distribution apparently depends to a large extent on the hydrogen ion concentration of the water, some species living under very acid conditions, others preferring alkaline surroundings; the range of hydrogen ion concentration for individual species, however, appears to be quite narrow. Among the Notommatinæ are some green forms belonging to the new genus *Itura*, which shelter symbiotic zoochlorellæ and have no gastric glands. The Dicranophorinæ have the mastax or pharyngeal mill specialised into forceps for capturing their prey, and the rest of the apparatus is very slender, the various differences being important in classification. Careful figures are given of the whole animal and mastax of more than seventy species, most of which belong to the genus *Dicranophorus*.

Sagitta FROM THE NORTH SEA AND BALTIC.—A recent issue of "Die Tierwelt der Nord- und Ostsee" (Lieferung XI, Teil VIIb; Akademische Verlagsgesellschaft m.b.H., Leipzig) contains amongst other groups the Chætognatha by W. Kuhl. There has been much controversy as to the distribution of *Sagitta bipunctata*, which, although still recorded for the North Sea by many workers, is not admitted by the author into the area covered. The policy of Ritter Zahony in restricting the species is strictly followed, and those forms hitherto regarded as *bipunctata* are put down to either *S. setosa* or *S. elegans*. Only three species of *Sagitta* are allowed in this work from the North Sea and Baltic, *S. setosa*, *S. elegans* (with the tree forms *elegans*, *arctica*, and *baltica*), and *S. maxima*, together with one species of *Eukrohnia*, *E. hamata*. Thus *Spadella* (*S. cephaloptera*), which is common in the neighbourhood of Plymouth, and probably is to be found in other parts of the Channel near the coast, is not recorded. The Chætognatha occur in enormous numbers in the plankton, and are interesting in their habits, being extraordinarily voracious and feeding on almost any planktonic animals available. As their food includes young fishes, especially the newly hatched herring, *Sagitta* is of practical economic importance as an enemy besides being useful as valuable food for the larger animals. The plankton-eating fishes and many cœlenterates, including medusæ and ctenophores, devour huge quantities of *Sagitta*, which, as is to be expected, act as intermediate hosts for a variety of parasites duly noted in the present work, the adult hosts usually being fishes which have eaten the *Sagitta*.

METAXENIA IN THE DATE PALM.—The problem of metaxenia (*i.e.* the direct effects of pollen on the parts of the seed and fruit lying outside the embryo and endosperm) has been investigated in the case of the date palm *Phœnix dactylifera* by W. T. Swingle of the U.S. Dept. of Agriculture (*Journal of Heredity*, vol. 19, No. 6). In this particular case, the pollen has been found to exert a direct influence on the size, shape, and colour of the seed, on the size of the fruit, on the speed of development of the fruit, and on the time of ripening of the fruits of the vegetatively propagated female varieties. This direct influence of the male parent is precise and definite, and varies with the particular males used to fertilise the female flowers, each male exerting the same effects on fruits of all varieties and producing the same result in different years. Metaxenia, unlike xenia, cannot be explained by hereditary elements or chromosomes brought in by the pollen, as no such chromosomes occur in the tissues that show the direct effect of the pollen parent. Swingle thinks that the simplest and most probable theory is that the embryo or endosperm or both secrete "hormones or soluble substances analogous to them," which diffuse out into the tissues of the mother plant that constitute part of the seed and fruit, and exert on these tissues a specific effect varying according to the particular male parent used. Evidence is adduced to show that the embryo and endosperm of the date show remarkable chemical activities during their development, and interact to some extent on each other, and probably on the near-by tissues of the seed and the surrounding ovary walls that constitute the fruit. In support of his theory Swingle mentions the 'growth stuff' found at the very tip of the coleoptile in germinating grasses according to Boysen-Jensen and Paál, and also describes some recent work on similar lines by F. W. Went.

FOSSIL MOLLUSCA FROM THE GALAPAGOS ISLANDS.—Some of the scientific results obtained by the expedition from the California Academy of Sciences to the Galapagos Islands in 1905–6 are now, after much delay, seeing light. One of the most important was the discovery by Mr. Ochsner of fossiliferous strata where hitherto only volcanic rocks were supposed to exist. A brief preliminary note on these by Dr. W. H. Dall was published in 1924 (*Geol. Mag.*, Oct. 1924), and now, both Dr. Dall and Mr. Ochsner having died early in 1927, the final preparation of their manuscript has been undertaken by Dr. G. Dallas Hanna (*Proc. Calif. Acad. Sci.*, Ser. IV, vol. 17). The deposits contain marine shells, and occur on three of the islands. That on Albemarle Island is believed to be of Pleistocene age; those on Indefatigable and Seymour Islands are thought to be of Pliocene age. From Albemarle 48 species were collected, of which 32 are still living in the Panamic fauna. On Indefatigable Island 68 species were found, of which 27 are still living and 23 apparently new, while Seymour Island yielded 9 species, of which two are living and 5 appear to be new. The characteristics of these fossils are typically American, but while most of the species belong to groups now represented in the Panamic fauna, there are a few which recall forms existing only on the Antillean side, and quite a number which belong rather to the subdivision of the Panamic fauna present in the Gulf of California, than to the warmer waters of the Gulf of Panama. The possible inference is that the Galapagos fossils were living in seas somewhat cooler than those at present surrounding the islands. Sketch maps of the islands, showing the localities of the deposits, with check lists of the fossils and full descriptions of the new species drawn up by Dr. Dall are given. Five plates from photographs taken by Dr. Hanna illustrate the paper, while portraits of the two authors are appended.

STRUCTURE CONTOUR MAPS OF OILPOOLS.—Those whose technical interests compel constant reference to such bulletins of the United States Geological Survey as are devoted to oilfield development can never fail to be impressed with the clarity and excellence of the structure contour maps provided, and with their real value in aiding visualisation of the attitude of underground oilpools. In Great Britain, the structure contour map is by no means as prominent in geological publications as it might be, though there are notable exceptions, especially in the coalfield regions. The usual criticisms levelled at American structure maps are that they tend to be geometrical and rather artificial, being, in fact, generalisations of supposed structures based on restricted well-data, hence often only true at certain precise points. This element of uncertainty is not in itself a vitiation of the data portrayed, nor reason for

passing over with scanty glance these interesting supplements to the literature. American oil geology, especially where it concerns the mid-continent and Rocky Mountain regions, lends itself directly to representation by means of structure contour maps, largely owing to the comparatively simple nature of the structures involved. One has only to mention such examples as the Cushing Oilfield, Oklahoma (*Bulletin* 658) and the Midway-Sunset field, California (*Prof. Paper* No. 116), to give point to these remarks, while the small publication on the oil and gas prospects of North Eastern Colorado (*Bulletin* 796-B), recently issued, contains one such map (plate 17), which, however artificial it may or may not be, serves to illustrate structural types and renders detailed perusal of the text unnecessary: this in itself may often be sufficient reason for blessing an organisation which possesses both knowledgeable enterprise and financial backing to publish periodically such useful contributions to science.

FIREDAMP EXPLOSIONS.—Safety in Mines Research Board Paper No. 42 (H.M.S.O. 6*d.* net) entitled "Firedamp Explosions. The Projection of Flame," by M. J. Burgess, is a continuation of a previous paper (No. 27). This recorded laboratory experiments, the conclusions of which have now been confirmed by tests on the experimental gallery 7½ ft. in diameter, installed at the Board's research station at Buxton. It was shown that even with a weak mixture containing 6·3 per cent only of methane, the flame produced on its explosion was projected 60 ft. into the pure air of the gallery, or more than twice the length of the column of gas mixture exploded. With richer mixtures the flame was projected further, the maximum being 4·5 times the length of the column of mixture containing 10·5 per cent of methane. When constrictions were left between the gas mixture and the air, the effects were more destructive. The results show that the flame of a firedamp explosion may be projected a considerable distance beyond the confines of the original mixture.

THE STRUCTURE OF FORMALDEHYDE.—A very complete description of the formaldehyde molecule is given by Prof. V. Henri and S. A. Schou in the issue of the *Zeitschrift für Physik* for July 26 (pp. 774-826), the data being obtained by applying the usual methods of analysis of molecular spectra to the absorption bands of the vapour in the ultra-violet. The molecule is Y-shaped, with the carbon atom at its centre, and the two hydrogen atoms placed symmetrically on opposite sides of the produced oxygen–carbon axis, its principal dimensions being H–H, 1·4 A.; C–O, 1·1 A.; and C–H, 1·3 A. It has two sets of vibration frequencies, corresponding to the natural frequencies of carbon monoxide and hydrogen, whilst since the observed electronic transitions are triple, there are probably four molecular valence electrons present, and the fundamental term is $3\,{}^3P$. Numerous other relations have also been found amongst the energy levels of formaldehyde itself, and between these and the levels of other atoms and molecules, but probably the most important consequence of the discussion of these is the prediction and discovery of a new absorption band of carbon monoxide near 2050 A. which is related to the Cameron emission bands. An incidental point of some interest which has emerged in connexion with the properties of formaldehyde in solution is that its absorption spectrum in hexane is similar to that of the vapour, whilst that in water is of a totally different character.

SOLUTIONS IN PURE ACETIC ACID.—Some preliminary experiments on the solubilities and chemical reactions of salts in pure acetic acid are described by A. W. Davidson in the *Journal of the American Chemical Society* for July. The results so far obtained show that many salts, such as calcium chloride or barium iodide, are readily soluble in acetic acid, and that double decomposition reactions take place as readily in this solvent as in water. Thus, silver chloride is precipitated from a solution of silver nitrate in acetic acid by the addition of sodium chloride. In some cases, however, the course of the reaction was found to be less familiar; for example, the addition of a drop of anhydrous sulphuric acid to the solution of any inorganic salt in acetic acid causes the precipitation of the corresponding sulphate. Even the sulphates of the alkali metals behave in this way, and sulphates, such as cupric sulphate, which normally form hydrates, separate in the anhydrous form even when some water is present. It is interesting to note that sulphates are also insoluble in liquid ammonia. The behaviour of many acetates in acetic acid closely resembles that of the corresponding hydroxides in water.

STRUCTURE OF MERCERISED CELLULOSE.—Mercerised cellulose gives a diffraction pattern with X-rays which is somewhat different from that of untreated cellulose, and from an examination of X-ray data obtained from mercerised ramie fibres, O. L. Sponsler and W. H. Dore have developed a space lattice for this material. Their paper, which appeared in the *Journal of the American Chemical Society* for July, also contains suggestions as to the probable mechanism of mercerisation. Untreated ramie cellulose appears to be built up of parallel chains of glucose units running lengthwise in the fibre, and the action of sodium hydroxide seems to cause a lateral shift of these chains in the wall of the fibre together with a partial rotation of the alternate glucose units in each chain. The hydroxyl group attached to each sixth carbon atom also appears to change its position. Sponsler and Dore conclude that mercerisation is not a progressive change dependent upon the concentration of the alkali solution as suggested by Herzog, but they consider that there is a critical concentration (about 13 per cent for sodium hydroxide) below which a permanent change does not occur. Their results also tend to support the view that the units of cellulose are connected in chains by primary rather than by secondary valence linkages.

PURE PHOSPHORUS TRIOXIDE.—The *Journal of the Chemical Society* for July contains an account by Christina C. Miller on the preparation and properties of pure phosphorus trioxide. Many attempts have been made to connect the glow of ordinary phosphorus trioxide with that of phosphorus, but it now appears that the luminescence of the oxide is due to the presence of dissolved phosphorus. The latter may be removed by low temperature recrystallisations followed by exposure to light and subsequent separation from the red product by volatilisation. The pure trioxide is a transparent, crystalline solid free from the waxy, opaque appearance of the impure substance, and melting at 23·8°, whereas the oxide prepared in the usual way melts at 22·4°. The pure substance neither glows nor oxidises in moist or dry oxygen, but when heated to 200° in a sealed tube with dry oxygen at 300 mm. pressure, a faint glow was observed. It dissolves phosphorus in small quantities and then regains all the properties generally ascribed to it.

The Fourth International Congress of Entomology.

THE fourth International Congress of Entomology, held at Ithaca, New York, on Aug. 12–18, was much more largely attended than any of the previous congresses of entomology. More than 650 delegates and associates were registered, and 36 different countries were represented. Unlike the Zurich congress of 1925, France, Italy, and Belgium sent official delegates. In all, more than one hundred persons came from foreign countries. The largest foreign delegations were those of England, France, Spain, Germany, and Russia. Very many Canadian entomologists were present, and Canada really joined with the United States in welcoming to North America the delegates from other parts of the world.

Ithaca proved to be an ideal place for the Congress. The buildings of Cornell University are admirably adapted to such gatherings; the summer climate is a good one; the so-called Finger Lake region of New York is one of great interest to naturalists, and the scenic beauty of that part of the State is very great. Since Cornell had experienced the organisation work for an international congress two years ago, when the botanists met there, every need was anticipated, and the delegates from abroad expressed themselves as greatly pleased by all of the arrangements and by the courtesy and hospitality shown by the people.

Many of the older European entomologists were absent. Lameere, of Belgium, the president of the first Congress, held at Brussels in 1909; Poulton, of England, president of the second Congress, held at Oxford in 1912; Handlirsch, of Austria, who would have been president of the Congress at Vienna in 1915 had it not been abandoned on account of the War; and von Schulthess, of Switzerland, president of the third Congress, held at Zurich in 1925, were all regrettably absent. But a large number of younger men were present, all of them being well known by their admirable published work.

Many notable papers were read at the morning general sessions. The speakers at these sessions were: René Jeannel of Paris, Karl Jordan of England, Ivar Trägardh of Sweden, E. L. Bouvier of Paris, Erich Martini of Hamburg, Walther Horn of Berlin, Filippo Silvestri of Italy, W. M. Wheeler of Harvard, W. J. Holland of Pittsburgh, M. N. Rimski-Korsakov of Leningrad, H. C. Efflatoun of Egypt, E. P. Felt of Connecticut, C. L. Marlatt of Washington, F. Heikertinger of Vienna, R. J. Tillyard of Australia, and A. D. Imms of Rothamsted.

The sectional meetings, which were held during the afternoons, carried out very full programmes. There were so many entomologists present who were interested in the economic phases of the science that it was necessary to establish several sub-sections under the Section of Economic Entomology. I was not able to attend any of the sectional meetings, but, judging from what I have heard, there was a very important forum on nomenclature, which was led by Dr. Stiles, the secretary of the International Commission on Zoological Nomenclature. Mr. J. E. Collin, president of the Entomological Society of London, advanced a protest against the use of abbreviations in descriptions, which excited much discussion, although the delegates nearly unanimously supported the speaker. Mr. F. W. Edwards, of the British Museum (Natural History), gave a most interesting account of his recent expedition to Patagonia, in which he brought out many points bearing upon the theory of a past land connexion between South America and Australia. Dr. Walther Horn's paper on the future of insect taxonomy was rather pessimistic, but proposed the formation of an international institute to form a clearing-house for entomological information.

In the forum on problems of taxonomy there was an active discussion of the question as to whether types should be deposited in one or two large museums or distributed in regional museums. An important paper on some effects of temperature and moisture upon the activities of grasshoppers and their relation to grasshopper damage and control was read by Dr. J. R. Parker of Montana; and J. W. McColloch and W. P. Hayes of Kansas discussed the problem of controlling underground insect pests. Dr. W. J. Baerg of Arkansas reported upon the general subject of the poisonous Arthropods of North and Central America in a paper which shed great light upon this much discussed subject. A. d'Orchymont of Brussels, P. Vayssière of Paris, J. P. Kryger of Denmark and Dr. James Waterston of the British Museum, read excellent papers in the Section of Systematic Entomology and Zoogeography. The Section of Forest Insects was fortunate in hearing papers from the well-known forest entomologists, Unio Salas of Finland, H. Eidman of Munich, and I. Tragardh of Sweden. The latter's paper on "Some Methods of analysing the Fauna of a Dying Tree" was of great value.

In fact, the whole programme was filled with interesting papers and discussions which would have interested the readers of NATURE greatly, and I am sorry that more space cannot be devoted to them.

I am sorry also, although I highly appreciate his courtesy, that the Editor of NATURE did not invite a European, instead of me, to write this account, since were I to emphasise many of the delightful features of the Congress, it would appear like the boasting of a prejudiced American. Expeditions in groups were made to Niagara Falls, to many of the picturesque spots of central New York, to Pittsburgh, Philadelphia, Washington, New York, and Boston, and a number of the delegates took long journeys into the far west. The members of the Congress greatly regretted the absence of R. Stewart MacDougall, of Edinburgh, who wrote for NATURE the delightful account of the Congress in Zurich in 1925, in which he played a very important part.

The European visitors were received, on landing at New York, by a committee composed of members of the New York and Brooklyn Entomological Societies and were given a formal dinner at the American Museum of Natural History. Those landing from the first vessel were taken on expeditions up the Hudson River and to various neighbouring points of interest.

After the Congress, a large party of delegates was received at the Carnegie Museum of Pittsburgh and given a formal dinner by Dr. W. J. Holland, the emeritus Director of the Museum. At Washington a special meeting of the Entomological Society of Washington was held which was attended by more than 200 entomologists. This meeting resolved itself into an intimate discussion of the entomological societies of the world, of their methods of procedure, and of the conditions of entomological science as represented by these widely spread organisations. At Washington also, in addition to visits to the U.S. National Museum, the U.S. Department of Agriculture, and places of historic interest, a reception and supper were given at the National Zoological Park, and a special expedition was taken to Plummers Island, a spot in the Potomac River north-west of Washington rather renowned for its interesting insect fauna, since here a remarkable mixture of southern

and northern forms occurs. Following these Washington meetings the delegates dispersed, many of them returning to New York for embarkation, others visiting other parts of the country. The well-known authorities on cave insects, Dr. René Jeannel of Paris and Dr. Candido Bolívar of Madrid, started for an exploration of the great caves of Indiana and Virginia in company with Mr. Herbert Barber and Dr. Harold Morrison of the U.S. National Museum.

I should not, perhaps, write of the address of the president of the Congress at Ithaca, since I held that office myself, but that the principal theme of the address was the necessity for a reform in the teaching of zoology in the colleges and universities, so that entomology should receive vastly greater attention.

As it happened, the fourth day of the meeting coincided with the eightieth birthday of Dr. W. J. Holland. A dinner was given him by some of his scientific friends and admirers, and he was elected one of the fifteen honorary members of the International Congresses. Dr. S. A. Forbes, the dean of the economic entomologists of the United States, now eighty-four years of age, was also made an honorary member. The Congress also adopted resolutions of sympathy and respect addressed to Prof. J. H. Comstock of Cornell (aged seventy-nine) and Dr. E. A. Schwarz of Washington (aged eighty-three).

Other resolutions were passed by the Congress. By far the most important step taken in regard to entomological nomenclature was a resolution by the Congress conferring upon the Committee of Nomenclature of the Entomological Congress judiciary powers to hand down opinions on cases of entomological nomenclature in accord with the International Rules of Zoological Nomenclature. It is understood that the entomological committee and the International Commission will co-operate; that in the future the Committee will handle most of the cases of entomological nomenclature and will refer to the International Commission only those cases involving pronounced differences of opinion, or undetermined principles, or the relations of nomenclature in entomology to nomenclature in other groups.

The Congress also adopted certain definite recommendations regarding family names, these recommendations to be referred to the International Commission with approval; and it referred certain other proportions to the Commission without prejudice.

I have attended fourteen international congresses of scientific men, and I have never seen at any of them such great enthusiasm and so obvious a spirit of hearty co-operation. Surely mutual understanding among the scientific men of the world is fostered greatly by these gatherings and makes for world peace.

L. O. HOWARD.

The Fisheries of Australia.

A RECENT statement from the Australian Development and Migration Commission throws light on the interesting position of the fishing industry in Australian waters.

The history of this industry shows a succession of failures to establish what should be a thriving part of Australian life. In 1907 the Commonwealth Government appointed a director of fisheries and provided a research trawling vessel, the *Endeavour*, to investigate the possibilities of trawling in the southern seas. After a number of experimental cruises, during which it was established that valuable fishing grounds existed in the Australian Bight and off Cape Howe, the *Endeavour* was lost at sea with all hands, including the Director of Fisheries, in December 1914. The trawler was not replaced, and little further was done by the Commonwealth Department of Fisheries.

In 1915 the New South Wales Government decided to establish a State trawling industry with seven steam trawlers as the nucleus of a trawling fleet. Despite the fact that some of the richest trawling areas in the world, namely, those extending southwards from Port Stephens to Gabo Island, were revealed by the operations of the State trawlers, the venture was not a commercial success, and in 1923 the trawlers were disposed of to a number of private companies. These companies have since successfully exploited the Sydney and Newcastle fish markets and show signs of extending their fields of operation. Queensland also undertook State trawling in 1919, and good trawling areas were located between Cape Moreton and Caloundra. In other States, however, the fishing industry has failed to develop to the degree shown possible by fish imports. It is an anomaly, indeed, that a nation which imports annually fish valued at more than £1,500,000, and has an adequate supply of good edible fish around its coast, should fail to exploit such excellent natural resources.

This feature has been clearly realised by the Development and Migration Commission, which deals with the development of industry within the Commonwealth, as a prior necessity [illegible] tion.

At the instance of the Commission, the first Australian Fisheries Conference was held in September 1927. This was attended by representatives of the Commission, of the Commonwealth Council for Scientific and Industrial Research, and of the departments of fisheries of the various Australian States. It was decided that a complete programme of development must include not only trawling and related industries, but also studies of transport, distribution, and marketing of fish, of uniform laws and regulations affecting the capture of fish, and of factors of destruction in fisheries. The establishment of marine biological stations and the cultivation of oysters, crayfish, and turtles were also considered. After a thorough discussion of the position in each of these branches, committees were appointed to go fully into each subject and to make recommendations to the second Australian Fisheries Conference, which is to be held during this year.

The field borders, on one side, those questions in marine biology to be studied by the British Association Expedition to the Great Barrier Reef, and on the other, economic investigations of trawling and the difficult problems of transport and distribution.

These terms of reference are clearly very wide and, in the present inquiries, close attention is being given to the mass of knowledge and experience which has been accumulated in European and American fisheries. While much of the data from these sources is capable of direct application to Australian conditions, there are numerous scientific and commercial problems which are peculiar to the southern waters.

Refrigeration applied to fish taken from Australian sea waters does not always give the same satisfactory results as when fish from colder and less saline waters are treated. Thus, although Atlantic salmon may be satisfactorily stored in a frozen state for up to two years, it has been stated that the Australian flat head becomes practically worthless after removal from a few months of cold storage. The reason for this difference is not clear, but it appears to be partly dependent on marine temperature and salinity. In

this case there is scope for useful research to determine the proper relations between temperature and salinity of sea-water and the best conditions for refrigeration of fish taken therefrom.

At the Conference held last year, the need for extending the pioneering researches on fishing grounds carried out by the *Endeavour* was considered in relation to the establishment of marine biological stations. It is a regrettable fact that there is an almost entire absence of trustworthy information about the seasonal migrations of the native fishes, their spawning habits and life histories, their growth-rate and ecology generally. As a result of the Conference, it now seems likely that in addition to a research trawling unit being provided at an early date there will be a vigorous advance, backed by the universities within the Commonwealth, on the marine biological problems in Australian waters. The visit of the present British Association Expedition to the Great Barrier Reef will undoubtedly have a stimulating influence in this direction.

Transport and distribution of fish in such an area as the south-eastern portion of Australia present perhaps the greatest hindrance to the rapid development of the fishery industry. Briefly, the problem is to develop that measure of co-operative organisation between fishery concerns, transportation agencies, and marketing bodies necessary for rapid and economic distribution from the three large centres of population—Sydney, Melbourne, and Adelaide—to the sparsely populated country districts. It is rightly felt that in Australia, until the problem of distribution is solved, research directed towards the increase of supplies is premature.

Governmental participation in industrial affairs nowadays trends rather to the removal of those factors hindering developments than towards State trading. It is in this spirit that the two Commonwealth Government departments—the Development and Migration Commission and the Commonwealth Council for Scientific and Industrial Research—are co-operating with State authorities to bring the light to economic and scientific problems affecting fishery developments in Australian waters and to point the way to their solution.

A. S. F.

Royal Photographic Society's Exhibition.

THE annual exhibition of the Royal Photographic Society is now open at 35 Russell Square, and admission is free. It closes on Oct. 13. We are glad to see that our oft-repeated desire that in the scientific and technical division the general appearance of the exhibits should be considered as secondary to their classification is this year acted upon to a certain extent, and to that extent the work of the student examining them is facilitated. What is now needed are a few cross-references in the case of exhibits that might belong to more than one section. For example, under the heading "Spectrography" there is only one item, but it would be entirely wrong to suppose that this is the only example of spectrographic work.

The Astronomer Royal has sent a photograph that shows the relative intensity of the principal doublet in the violet (H, K) and the diffuse doublet in the infra-red of the calcium chromospheres. The photograph was taken with a diffraction grating in the reflecting spectrograph with the slit tangential to the edge of the lens. The infra-red is of the first order and the violet of the second order, and they were photographed simultaneously, using light filters to exclude overl[illegible] spectra. The 'astra' light filter is a new filter [illegible] Ilford, Limited, for use when photographs are taken with visually corrected refracting telescopes. It eliminates the secondary spectrum to a very considerable extent. Mr. A. Coleman demonstrates the advantages of this filter by photographs taken with and without it. Ten examples of Zeeman effects (the effect of a magnetic field on lines of the spectrum) are shown by Mr. A. S. M. Symons of the Imperial College of Science. Messrs. Green and Freeman show a series of Fabry and Perot interferometer fringes.

Of the numerous examples of photomicrography, the most notable are of slowly cooled steel by Col. N. T. Belaiew at magnifications of 200 and 2000, which illustrate the deformation of crystals of cementite under the influence of internal stresses due to an allotropic transformation in the matrix. Other interesting points with regard to the nature of these crystals are clearly shown. Dr. G. H. Rodman has two series of nearly thirty each, showing the life history and structure of the greenhouse white fly and of *Zygina* (*Erythroneura*) *parvula* respectively, the latter being a pest that has lately become very prevalent at Kew and in greenhouses round London. Each is accompanied with rather long descriptive and explanatory notes.

The present possibilities of the photography of bullets in flight are well shown by Mr. Philip P. Quayle of Ohio. Spark photographs of the firing of a 0·30-calibre Springfield show the state of affairs (1) as the bullet emerges from the muzzle, (2) when the bullet has travelled about 6 inches, and (3) when it is about 18 inches from the muzzle. Similar photographs of the firing of a 12 gauge Winchester shot gun, full choke, show the charge as it leaves the muzzle and at distances from it of 4 inches and 12 inches and at 11 yards.

Some fine examples of X-ray photography are contributed by Kodak, Limited; Ilford, Limited; and Dr. J. H. Mather. Kinematography, photography in colours, photography from the air, telephotography, and practically every branch of photography are well illustrated in the exhibition.

The trade section of examples and apparatus seems to be rather larger than usual, a good deal of the apparatus being designed specially for scientific work. A light of standard quality for testing photographic negative materials is contributed by The British Photographic Research Association. This exhibit comprises a standard lamp, and a colour filter as worked out by Messrs. R. Davis and K. S. Gibson, of the Bureau of Standards, Washington, to make the light similar to ordinary average daylight.

University and Educational Intelligence.

LEEDS.—The foundation-stone of the new buildings will be laid by the Duchess of Devonshire on Oct. 2. After the ceremony a congregation will be held in the Great Hall of the University to confer the honorary degree of Doctor of Laws on Her Grace, Sir A. E. Bain, Mr. Alexander Campbell, and Mr. Morton Latham.

WE have received from the Bradford Technical College a prospectus of diploma and special day courses for 1928–29, including three- and four-year diploma courses in textile industries, chemistry, dyeing, civil, mechanical, and electrical engineering, physics, and biology. Special courses in advanced study and in training in the methods of research, special courses involving full-time attendance during one or two years, and part-time day courses are also offered. The relations of the College with industrial firms have of late been extensively developed by the arrangement of visits to local chemical and dyeing

Calendar of Customs and Festivals.

September 27.

ST. COSMAS and ST. DAMIAN, who are said to have been beheaded under Diocletian in Italy, have appropriated the cult of a deity connected with fertility. Sir William Hamilton, ambassador to the court of Naples at the end of the eighteenth century, recorded that at the church of St. Isernia it was the custom of Italian women to make votive offerings of phallic character to these saints to secure children. They are in particular the patron saints of physicians and surgeons, as well as of philosophers.

September 29.

GANGING DAY.—A septennial custom at Bishop Stortford, when a group of young men assembling in the fields chose one of their number as leader, whom they followed over fields, ditches, and places of difficult passage. All whom they met, whether male or female, were 'bumped,' two persons taking them up in their arms and swinging them against each other. The landlord of each inn they visited was bound to furnish them with ale and cakes. The night should be, and usually was if the weather permitted, spent in the fields.

MICHAELMAS.—The feast of St. Michael being the most important of the Church festivals which approximates in date to the close of the agricultural year with the harvest, a number of customs have come to be associated with it which either close the old or inaugurate the new season. Such are the choice and inauguration of the new officials of the community for the coming year, or the renewal of terms of tenure. These are often marked by some special observance, such as the chopping of a stick by the senior alderman present in acknowledgment of the service of a manor in Shropshire, or the presentation of the horseshoes and nails on behalf of St. Clement's in the London civic ceremonial. At Abingdon the streets used to be decorated with flowers and garlands hung on poles at the inauguration of the new mayor at Michaelmas; while at Nottingham a ceremony known as the Burial of the Mace took place in St. Mary's Church, when the mace was laid on a table in the vestry beneath sprigs of rosemary and bay before it was handed to the new officials.

That the election was a time of special privilege and the place of assembly of a special character—in early times such communal assemblies were held in temple or sacred grove—is perhaps indicated by the custom of Seaford in Sussex, where the freemen, after assembling in the town hall, retired to the gate-post of a field at one end of the town and there elected their mayor, in order, it was said, to be free from the influence of the jurats who were sitting on the bench in the town hall. The 'lawless hour' of Kidderminster (see Oct. 1) finds its parallel in the 'lawless court' of King's Hill in Essex, at which tenants did suit and service before cock-crow. There are other cases, such, for example, that at Roscarrock in Cornwall, in which service of tenure had to be performed before sunrise, a time which, sometimes, at any rate, appears to have been regarded as a 'lawless' hour.

The fair at Chichester which began on this day, and lasted for eight days, was another of the occasions on which civil authority was abrogated. Here it was delegated to the bishop, who collected all tolls. On one occasion he claimed, but without success, the right to hold the keys of the town.

Among customs of a more popular character, the late harvest of the north of Scotland is responsible in Skye and other islands of the west coast for the baking of a huge cake on this date. Of this all the members of the family and any strangers had to partake. It was also customary, where conditions allowed, to hold horse races, and for the sexes to give one another presents. A curious custom of the island of Lingay mentioned in the early eighteenth century was that any one might steal his neighbour's horse the night before and ride it all day provided that he returned it unharmed. In Barra the women brought the horses and rode behind the men, it being a lucky sign if they fell off. They bore the expenses, and each brought a large bannoch made with treacle, butter, etc. In Skye it was the practice that the cavalcade should ride round the church, which is strong presumptive evidence of a religious and probably pagan origin.

The Michaelmas cake appears in Ireland, where the inclusion of a ring makes it a prognostication of the marriage before the next Michaelmas of the one who received the portion containing it. In the west of England also, Michaelmas was made an occasion for forecasting marriage. Girls gathered ripe crabs from the hedges and laid them out in the form of initials in a loft. The initial which best retained its shape on Old Michaelmas Day was that of the future lover or husband.

St. Michael's cake was also baked in Wales, where it was incumbent upon every member of the household to eat a share.

Many attempts have been made to explain the Michaelmas goose. Its origin as a Michaelmas dish has been attributed to Queen Elizabeth and the celebration of the news of the defeat of the Armada; but it is mentioned long before in the reign of Edward IV. As it is a dish eaten at this date in Denmark and in Germany, its origin is probably more universal. The name sometimes given of 'stubble goose,' and the fact that geese having been allowed the run of the fields after the harvest were then at their best, suggest that it was probably a convenient form for payment in kind, especially for dues and tenancy—a view which is supported by numerous references to it in this connexion—and hence became an appropriate and staple dish for the Michaelmas feast.

SNAKE WORSHIP IN SOUTHERN INDIA.—In Malabar the snake is held in special reverence, and in some corner of the garden of every respectable family is a little grove with a masonry platform on which are sculptured granite stones representing hooded serpents. Every evening a lamp is lighted and offerings of eggs, milk, and plantains are made after the lamp has been lit to invoke the serpent's aid.

Mannarsala in Travancore is well known for its serpent worship. Here in a grove live the snake king and queen with thousands of their followers in the form of snakes of granite. A priest is in attendance who is provided with a house in the grove. An annual festival, known as the Ayilyam festival, is held here in the months of Kanny and Thulam (September-October) when a large number of people assemble with offerings of gold, silver, salt, melons, etc. On the day preceding the festival something like three thousand Brahmins are entertained at the house of the priest. On the day of the festival the serpent gods are taken in procession to the house of the priest by the eldest female member of the house, and offerings of neerumpalum (a mixture of rice-flour, turmeric, ghee, water of tender coconuts, etc.), boiled rice, and other things are made to the serpent gods. It is said that the neerumpalum mixture would be poured into a big vessel and kept in a room for three days, when the vessel would be found empty, the serpents having drunk the contents.

Societies and Academies.

PARIS.

Academy of Sciences, Aug. 6.—A. Lacroix: The pegmatitoids of volcanic rocks with basalt facies.—**S. Winogradsky**: The oxidation of cellulose in the soil. The greater part of the work of the disintegration of cellulose in the soil is done by aerobic organisms. A method of culture is described which permits of the direct observation of the changes in the structure of filter paper brought about by the organism under examination.—**V. Grignard and J. Dœuvre**: Citronellol and rhodinol. The results of a quantitative study of the products of the ozonisation of rhodinol. It is concluded that the rhodinol of Barbier and Bouveault does not exist as a chemical entity in natural essential oils.—**O. Borůvka**: A class of minimum surfaces plunged in a space of four dimensions with constant curvature.—**A. Danjon**: The photometric study of the earth shine from the moon.—**Pierre Leroux**: Study of the influence of the temperature on the absorption of a specimen of tourmaline. The apparatus utilised for the absorption measurements consisted of a photo-electric cell with a quadrant electrometer. For temperatures not exceeding 250° C., the variation of the absorption coefficient as a function of the temperature is linear and reversible.—**Minesaburo Akiyama**: The condensation of water vapour on the charged atoms of actinium-A.—**C. Marie and G. Lejeune**: Researches on the electrolytic oxidation of organic substances.—**Rangier**: The condensations of glycerol. A detailed study of the products obtained by heating glycerol with fused sodium acetate at varying temperatures.—**G. Vavon and N. Zaharia**: The extractibility of phenols by ether starting with their alkaline solutions. It is usually assumed that a mixture of phenols with other ether soluble substances can be separated by making the mixture alkaline and extracting with ether. This is not the case, since all phenols are partly removed from alkaline solution by ether, the quantity varying with the structure of the phenol.—**V. Babet**: The crystallophyllian rocks of the Mayombe (French Equatorial Africa).—**Henri Termier**: The ankaratrites of Central Morocco.—**Pierre Lamare**: A type of tectonic accident affecting the lower folds of the Pyrenees of the Spanish Pay Basque.—**Raymond Furon**: Geological observations on the Hodh (Circle of Néma, French Sudan).—**Jules Welsch**: Contribution to the knowledge of the Jurassic fauna of Poitou. Oxfordian Ammonites to the south of Niort. —**M. Collignon**: Explosions at a great distance.—**Emile F. Terroine and R. Bonnet**: The modes of utilisation by the organism of the energy set free by oxidations and the problem of the food value of alcohol. It is concluded that oxidations in living organisms fall into one of two classes: in one class, of which the oxidation of glucose is the type, the energy can be utilised both for mechanical and chemical work; the other class, of which alcohol is the type, can only give rise to heat.—**E. Kohn-Abrest and Lupu**: The fate of hydrocyanic acid in the blood.

CAPE TOWN.

Royal Society of South Africa, July 18.—J. W. C. Gunn: A note on the skin secretion of *Xenopus lævis*. The South African clawed toad, *Xenopus lævis*, when irritated by mechanical, electrical, or chemical stimuli applied to the skin, on the inhalation of irritating gases, or after the injection of certain drugs, secretes a white viscous fluid from its skin. This consists mainly of albuminous material, but contains substances which are pharmacologically active and toxic to mammalia. A specimen of dried secretion has remained active for six years. One of the active substances has sympatho-mimetic actions similar to adrenaline, but does not give the chemical reactions of adrenaline. An extract from the entire skin has a similar action to that of the secretion.—**J. W. C. Gunn and Louis Mirvish**: A preliminary note on the pharmacological action of *Homeria collina*. This tulip is known in the Cape Province as the yellow plant or géel tulip. The material was dried, powdered and macerated in 70 per cent alcohol for forty-eight hours. The resulting tincture was employed in the experiments. Immediately before use the alcohol was driven off and replaced by an equivalent amount of Ringer's solution. Its effects are similar to those produced by the Digitalis group of drugs.—**L. Mirvish and L. P. Bosman**: (1) The effect of testicular extracts on the calcium blood-level. It is only when alcoholic extracts of testes given are increased to the extent equivalent to about 200 gm. of fresh testicular substance that a drop in the blood calcium occurs similar to that caused by ovarian extract. The same hormone that is present in the ovary appears to be present in the testis, but in lesser concentration. (2) The effect of extracts of the suprarenal cortex on the calcium blood-level. Bovine suprarenals from which the medulla was removed were extracted with alcohol. The adrenaline was removed, and the alcoholic extracts purified as in the preparation of the ovarian extract. This extract, when injected into rabbits, reduced the blood calcium by about 30 per cent. The nature and extent of the drop were similar to that produced by the ovarian extract.

ROME.

Royal National Academy of the Lincei, May 6.—A. Bemporad: The astrographic catalogue of Catania.—**A. Angeli**: Diazo-compounds. Further data and considerations concerning the behaviour of the diazo-compounds, like those previously published, allow of a satisfactory explanation of the reactions of such compounds without the aid of the hypothesis of stereoisomerism.—**J. Dubourdieu**: Certain applications of the theory of geodesic co-ordinates along a curve.—**L. Fantappiè**: The linear functionals of functions of two complex variables (3).—**Elena Freda**: The propagation of stationary electric currents in a conductor subjected to the action of a uniform magnetic field.—**L. Tieri and V. Ricca**: Electronic emission in a vacuum tube. Results are given of experiments made to determine the relationship between the variations of the filament current and those of the electronic current as the potential difference between the filament and the plate is varied. An interpretation of these results is to be given later.—**E. Fermi**: The statistical deduction of certain properties of the atom: calculation of Rydberg's correction for the S terms (3). It has been shown previously that the whole of the electrons surrounding the nucleus of a heavy atom may be regarded as a kind of gaseous atmosphere of electrons in conditions of complete degeneration. Application to the study of this question of a statistical method permits of the determination of the distribution of the electrons round the nucleus and of the mode in which the electric potential varies inside the atom as a function of the distance from the nucleus.—**C. Dei**: Circuits with a thermionic valve in derived saturation on a condenser.—**E. Perucca**: Polarimetry and photoelectric photometry. Todesco's photo-electric method for revealing slight traces of double refraction is useful, not so much as a means of measuring double refraction, but, as a highly sensitive zero method, to replace the eye in polarimetric and photometric measurements. The arrangement suggested by Todesco allows of the determination of the extinction azimuth of the analyser with respect to the polariser (crossed nicols) with an accuracy of about 1·5″, and is, there-

fore, at least as efficient as the best half-shadow polarimetric devices.—M. Baruzzi: Further considerations on the periodic course of the mean diurnal temperature at Modena.—G. Malquori: (1) The system $KCl - HCl - H_2O$ between 0° and 80°. The presence of hydrochloric acid lowers the solubility of potassium chloride in water, but does not change the form of the curve expressing the solubility as a function of the temperature.—(2) The system $AlCl_3 - HCl - H_2O$ between 0° and 80°. In the system $AlCl_3 - H_2O$, the compound $AlCl_3, 6H_2O$ alone exists in equilibrium with the saturated solution from the cryohydric point to 80°. From the heat of solution of $Al_2Cl_6, 12H_2O$, in 900 molecules of water at 15·5°, determined by Sabatier, and the corresponding heat of dilution, now measured, it is calculated that the formation of a saturated solution at 20° from 1 molecule of $AlCl_3, 6H_2O$ is accompanied by the generation of +4606 cal. Just as with potassium chloride, so with aluminium chloride, the solubility is depressed by the presence of hydrochloric acid, but the solubility-temperature curve is not changed in shape.—(3) The system $AlCl_3 - KCl - H_2O$ between 0° and 80°. The solubility surfaces for this system are perfectly normal, the ratio between KCl and $AlCl_3$ in the saturated solution exhibiting, with rise of temperature, a certain variation in the direction of enrichment with the potassium salt.—G. A. Barbieri: The cobalti-carbonates.—S. Pastorello: The stability of rhodium sesquioxide and iridium dioxide. In an atmosphere of sulphur dioxide, rhodium sesquioxide is comparatively, and iridium dioxide highly, stable. Confirmation is obtained of the view that the formation of these oxides is the cause of the depression of the catalysis of sulphur dioxide to trioxide by the presence in the platinium catalyst of rhodium or iridium.—E. Pace: Ditertiary glycols and some of their heterocyclic derivatives. Various glycols of the form $CH_3.CR(OH).CH_2.CH_2.CR(OH).CH_3$ have been prepared by the action of magnesium alkyl bromides on acetonylacetone and treatment of the resulting product with water. By the action of dehydrating agents on these compounds, tetrahydro-furfuran derivatives are formed, and by the action of alcoholic ammonia solution, tetrahydropyrrole derivatives.—N. A. Barbieri: Tabacin or the toxic principle of tobacco. Tabacin, which may be regarded as an acid-nitrogenated glucoside, is decomposed by 2 per cent potassium hydroxide solution into its components, tabacol, tabacinic acid, and sugar, and at about 110° emits irritating tabacol vapour, which causes violent sternutation, coughing, and pronounced respiratory trouble. Both tabacin and nicotine cause death in guinea-pigs in doses of 9 milligrams per 100 grams of body weight. Tabacol is a very powerful convulsant poison, which, by the rapidity with which it proves fatal when injected, recalls the combined action of hydrocyanic acid and strychnine.—Enrico Clerici: An interesting outcrop of lava at Petronella.—M. Comel: Variation in the hydrogen ion concentration of equilibrating solutions by the action of the regulating power of the tissues. Experiments with pulped muscular and liver tissue show that this tissue exerts a marked influence on the hydrogen ion concentration of regulating phosphate solution, the relation between the value of the resulting $pH(y)$ and that of the $pH(x)$ of the solution used being expressed by the straight line formula, $y = a + bx$.—M. Pennacchietti: The significance of the degeneration of the reticular zone of the suprarenal of the new-born human organism.—Aldo Spirito: Observations on the grafting of the primary optical vesicle in *Rana esculenta* on the influence of the various embryonic stages in the subsequent differentiation.

Official Publications Received.

BRITISH.

New South Wales. Department of Public Instruction: Technical Education Branch. Technological Museum: Curator's Annual Report for Year ended 31st December 1927. Pp. 5. (Sydney, N.S.W.: Alfred James Kent.)

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 23, 1927, No. 1. Pp. 246+5 plates. (Calcutta.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1927, to March 31, 1928. Pp. 8. (Sidmouth.)

Trinidad and Tobago: Council Paper No. 67 of 1928. Conservator of Forests: Administration Report for the Year 1927. Pp. 18. (Trinidad, B.W.I.: Government Printing Office.) 8*d*.

Forestry in the Colony of Trinidad and Tobago. Statement prepared by the Conservator of Forests, Trinidad and Tobago, 1928. Pp. 26. (Trinidad, B.W.I.: Government Printing Office.)

FOREIGN.

Pubblicazioni della Università Cattolica del Sacro Cuore. Serie sesta: Scienze Biologiche. Vol. 4: Contributi del Laboratorio di Psicologia e Biologia. Serie Terza. Pp. v+436. (Milano: Società Editrice "Vita e Pensiero.") 40 lire.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 145-148: On the Oxidation of Stannous Hydroxide in Sodium Carbonate Solution by Air, by S. Miyamoto; On the Oxidation of Sodium Sulphite in Sodium Carbonate Solution by Air, by S. Miyamoto; On the Oxidation of the Mixture of Stannous Hydroxide and Sodium Sulphite in Sodium Carbonate Solution by Air, by S. Miyamoto; On the Dissolution Velocity of Oxygen into Sodium Hydroxide, Sodium Carbonate and Hydrochloric Acid Solution, by S. Miyamoto. Pp. 225-245. 35 sen. No. 149: Photographic and Kinematographic Study of Photo-Elasticity. By Z. Tuzi. Pp. 247-267. 40 sen. No. 150: Electric Explosions. By H. Nagaoka and T. Futagami. Pp. 269-288+plates 25-36. 55 sen. No. 151: The Slip-Bands produced when Crystals of Aluminium are Stretched. By K. Yamaguchi. Part 1. Pp. 289-317+plates 37-42. 55 sen. No. 152: The Stark Effect of Balmer Series at High Field. By Y. Ishida and S. Hiyama. Pp. 14+2 plates. 30 sen. Supplement, Vol. 8, No. 1: On the Use of Quartz Rod or Sphere for Condenser in Spectroscopy. By H. Nagaoki. Pp. 3. 10 sen. (Komagome: Iwanami Shoten.)

CATALOGUES.

Books, Engravings, Original Drawings, Maps, etc., relating to South and Central America; with Short Lists on Cuba, Hayti, Porto Rico and Falkland Islands. (Catalogue 508.) Pp. 68+6 plates. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, SEPTEMBER 21.

SOCIETY OF GLASS TECHNOLOGY (in St. Peter's Hall, Bournemouth), at 2.—I. Kitaigorodsky and S. Rodin: The Value of the Thermal Expansion Factor of Aluminium Oxide in Glass.—D. Starkie and Prof. W. E. S. Turner: A Study of the Ultra-Violet Light Transmission of Glass.—At 4.30.—Prof. W. E. S. Turner: Modern Art Glass (Lecture).

THURSDAY, SEPTEMBER 27.

INSTITUTE OF BREWING (Yorkshire and North-Eastern Section) (at Queen's Hotel, Leeds).—G. P. Haworth: Barleys and Malts.

PUBLIC LECTURE.

FRIDAY, SEPTEMBER 28.

CHARACTER BUILDERS' ASSOCIATION (45 Lancaster Gate, W.2), at 8.—T. Cooke: Characteristics of the Temperaments.

CONGRESSES.

SEPTEMBER 19–25.

FOLK-LORE SOCIETY JUBILEE CONGRESS, 1928 (at Society of Antiquaries).

Friday, Sept. 21.

At 10 A.M. and 2.30 P.M.—
Prof. H. J. Rose: Mummers' Plays in Attica.
Prof. R. M. Dawkins: The Study of Folk-lore in Modern Greece.
Mrs. Hasluck: A New Dervish Order in Albania.
Prof. Gwynne Jones: Some Survivals of Folk-belief in Modern Wales.
M. Beza: Demetrius Contemir's Contribution to Folk-lore.
Mrs. H. H. Spoer: Hebrew Amulets.

Saturday, Sept. 22.

Excursions to Oxford and Cambridge.

Monday, Sept. 24.

At 10 A.M. and 2.30 P.M.—
Prof. Pettazzoni: Confession of Sins in Primitive Religions.
Dr. J. L. Myres: Paper.
Miss B. C. Spooner: The Fragments that are Left in N.E. Cornwall.
Dr. MacCulloch: The Arthurian Legend.
Miss Mona Douglas: Animals in Manx Folk-lore and Song.
R. E. Enthoven: Tree and Animal Worship in Western India.

At 8.30 P.M.—
(At Caxton Hall.) Demonstration of Folk-dances; Children's Singing-games; Folk-songs.

...esday, Sept. 25.

At 10 A.M. and 2.30 P.M.—

Prof. Elliot Smith: The Survival in English Folk-lore of a Story from the Rig-Veda.

...ysis and Folk-lore.

Dr. ...: Mother Earth and the Children of the Sun.

H. Simpson: Medical Magic among the Berbers of Algeria.

Prof. G. Schütte: Bull Worship among the Kimbri.

SEPTEMBER 22–28.

...OMMISSION INTERNATIONALE DE L'ÉCLAIRAGE (at Saranac Inn, New York).

...pt. 24.

C. C. Paterson: The British Standard Specification for Street Lighting.—L. Schneider: Die physiologischen Grundlagen der Strassenbeleuchtung.—A. K. Taylor: The Reflection Characteristics of Road Surfaces.—Calcul de l'éclairement moyen des voies publiques et des espaces découverts.—J. W. Ryde and Doris E. Yates: The Divergence of Beams from Parabolic Reflectors.—L. B. W. Jolley: The Automobile Headlight and its Standardisation, chiefly with Reference to the Linear Filament.—J. Wetzel: Étude de la repartition du flux des appareils de l'éclairage.—H. Desarces and D. Demeure: Définition des appareils de l'éclairage par la méthode de la répartition du flux.

...pt. 25.

P. J. Waldram: Daylight and Public Health.—J. G. West: Planning for Daylight.—J. A. Macintyre and H. Buckley: The Protection of Pictures and Museum Specimens from Fading.—H. H. Kimball: Distribution of Energy in Daylight.—P. Good: International Organisation.

...pt. 26.

M. Cohu: Essais concernant l'influence de l'eclairement sur le rendement et la fatigue dans les travaux manuels.—W. Trub: Principles of Illumination.—A. Blondel: Sur les grandeurs et unités Photometriques.—W. Dziobek u. M. Pirani: Normung von Signalglasern.—J. Guild: On the Selection of a Suitable Yellow Glass for Railway Signals.—F. Cellerier: Applications scientifiques du rayonnement de la lumière à l'étude des peintures des musées et collections.

E. Lau: Entladungsrohr fur photometrische Messungen insbesondere im Ultraviolett.—H. Buckley: Some Problems of Inter-reflection.

M. Luckiesh: Contributions to the Lighting Art from Researches in Light and Vision.—D. M. Moore: Gaseous Conduction Lamps.—J. Wetzel: L'application des principes rationnels a l'eclairage decoratif.

...pt. 27.

J. M. Waldram: The Precise Measurement of Optical Transmission, Reflection and Absorption Factors.—E. Lax, M. Pirani und H. Schonborn: Experimentelle Studien über Flussigkeitsmodelle truber Medien.

W. Dziobek: 'Diffuse' und 'direkte' Durchlässigkeit und Methoden zur Messung derselben.—C. Müller und R. Frisch: Über die Realisierung der Warburgschen rationellen Lichteinheit.—C. Muller: Über die Realisierung einer rationellen Lichteinheit mit Hilfe absoluter [illegible]

Laboratory in Teddington und dem Eidg. Amt für Mass und Gewicht in Bern.—W. S. Stiles: Recent Measurements of the Effect of Glare on the Brightness Difference Threshold.—P. S. Millar: Glare.

SEPTEMBER 24–27.

...TERNATIONALE TAGUNG FÜR BRÜCKEN- UND HOCHBAU (at Vienna).

SEPTEMBER 24–27.

...ERNATIONALE TUBERKULOSEKONFERENZ (at Rome).

SEPTEMBER 24–28.

...E TAGUNG DER BALTISCHEN GEODÄTISCHEN KOMMISSION (at Berlin).

SEPTEMBER 24–OCTOBER 6.

...ORLD POWER CONFERENCE—FUEL CONFERENCE (at Imperial Institute).

...ection A: The Coal Industry—Economic and General Considerations.

The Coal and Lignite Resources of the Australian Commonwealth.—The Combustion of Brown Coal in the Australian Commonwealth.—Dr. A. Gstöttner: The Coal Industry in Austria.—Austrian Coal—Technical Characteristics of the more important Varieties.—Dr. E. Stansfield: A Study of Post-Carboniferous Coals.—J. Formánek: Methods used for the Improvement of Lignites in Czechoslovakia.—A. D. Kissel: The Use of Coal as a Fertiliser.—D. J. L. C. Westenberg: Methods of Burning Dutch East Indian Coals.—Prof. M. Kamo: Korean Coals and their Utilisation.—Some Considerations regarding the Rational Utilisation of Roumanian Lignites.—Prof. L. K. Ramzin: (*a*) Utilisation of Low-Grade Fuels in U.S.S.R.; (*b*) Characteristics and Classification of Fuels in U.S.S.R.—Prof. J. A. de Artigas: The Calorific Value of Industrial Fuels.—Prof. R. V. Wheeler: The Constitution of Coal.—F. C. Wirtz: The Use of Fuel in the Netherlands.—Basis of Evaluation of Fuel Resources.

Section B: Sampling and Testing of Solid Fuels.

Sampling and Testing of Coal.—S. Felsz: A Practical Comparative Basis for the Calorific Value of Coal.—R. Vondráček: (*a*) Determination of Volatile Matter in Coal by Low Temperature Methods; (*b*) The Hygroscopic Qualities of Coals.—E. Norlin: On the Determination and Denomination of Values and Qualities of Coal.

Section C: Coal Treatment—(a) Cleaning, (b) Drying, (c) Briquetting.

Coal Cleaning.—Prof. H. Fleissner: The Drying of Brown Coal without Breakage.—R. A. Mott: The Dewatering and Drying of Coal.—Dr. W. R. Chapman: The Cleaning of Coal, with special reference to the Smaller Sizes.—E. Edser and P. T. Williams: The Cleaning of Coal by Froth Flotation.—G. Raw: The Dry Cleaning of Coal.—Major K. C. Appleyard: The Dry Cleaning of Coal.

Section D: Storage and Handling of Solid Fuels by the User.

H. Chenu: Methods of Control, Preparation, Handling, and Storage of Coals by the National Railways of Belgium.—G. J. Wally: Storage and Handling of Lematang Admiralty Coal.—D. Allemand: Storage, Handling, and Transport of Ombilin Coal at Emmahaven.—R. K. Stockwell: The Storage and Handling of Solid Fuels by the User.

Section E: The Oil Industry—Economic and General Considerations.

E. H. Davenport: The Economics of the Oil Industry, including the Influence of By-Products.—Keizaburo Hashimoto: The Oil Industry in Japan.—Natural Gas as a Source of Power.

Section F: Composition, Classification, Preparation, Storage, and Handling of Liquid Fuels.

The Characteristics of Motor Spirit.—K. A. Clark: The Availability of the Alberta Bituminous Sands for Production of Fuel Oil.—Wa. Ostwald: Properties required of Liquid Fuels for Use in Automobile and Aircraft Engines, and how the Oil Industry meets those Requirements.—Dr. A. E. Dunstan and J. Kewley: (*a*) Modern Developments in Oil Distillation; (*b*) Modern Developments in Oil Refining.—Prof. J. Elin: The Composition and Chemical Properties of Russian Oils.—B. Holmberg: Investigations in Distilling Processes of Swedish Oil Shales.—Dr. A. E. Dunstan and J. Kewley: Modern Developments in Oil Cracking.—The Cracking of Oil.—I. Lubbock: The Technical Aspects of the Storage, Handling, and Transmission of Liquid Fuels by the User.—Shale and the Production of Oil from Shale.—Oil Cracking.—Dr. K. Kling, L. Suchowiak, W. Leśniański, K. Katz, Dr. W. Dominik, and J. Wójcicki: Chemical Composition of Polish Natural Gases and the Determination of their Calorific Value.

Section G: The Carbonisation Industry—Economic and General Considerations.

B. F. Haanel: The Bearing of High and Low Temperature Carbonisation and Synthetic Fuel Processes on Canada's Fuel Problems.—K. Rummel: Heat Transfer through the Walls of Coke Ovens.—N. F. Nissen: The Use of Gross and Net Calorific Values for the Purpose of Guarantee Tests.—Hr. Elvers: Points of Importance for an Economical Comparison of the Value of the Heat Unit in Gaseous and Solid Fuels.—C. P. Finn and R. Ray: The By-Product Coke Oven as a Source of Industrial and Domestic Energy.—M. Mackenzie: The Economics of Coke Manufacture in the Coke Oven Industry.—W. Colquhoun: Coke Quenching and Cooling.—Prof. W. A. Bone, Prof. G. I. Finch, and Dr. D. T. A. Townend: The Fundamental Aspects of Combustion.—F. W. Goodenough: The Gas Industry as a Source of Domestic and Industrial Energy.—T. P. Ridley: The Utilisation of Coke Oven Gas by the Gas Industry.—Sakura Okamoto: A Brief History of the Gas Industry in Japan.—W. S. Edwards: Coke Screening.

Section H: Composition, Classification, Preparation, Storage, and Handling of Gaseous Fuels and of the Products of the Carbonisation Industry.

Uniform System of Designation for Gaseous Fuels.—Dr. H. Löffler: The Application of the Explosion Principle to Evaluation of the Heating Value of Gases.—The Testing of Gaseous Fuels.—Dr. W. Bertelsmann and Dr. F. Schuster: The Properties of Gases defining their Combustion.—F. Menzel: The Production of Gas and the Recovery of other Products by Carbonisation in the Vienna Municipal Gas Works.—Anthracite Substitute—Production of Solid Smokeless Fuels, whether by means of Low Temperature Carbonisation or by means of an Improved Coke.—Dr. J. G. King: The Fundamentals of Coal Blending and the Production of Solid Smokeless Fuel for Domestic Heating.—Prof. J. W. Cobb: The Production of Town's Gas and the Trend of Development.—C. Cooper: The Purification of Coal Gas.—Coke Oven Practice and Developments in Bulk Carbonisation.—Yoshikiyo Oshima: Coal Carbonisation in Japan.—J. Kewley: The Production of Gaseous Fuel from Liquid Fuels.—P. Parrish: By-Product Recovery in the Carbonisation Industries.—Prof. Bunte: New Methods of Fuel Analysis.—M. Langrogne: Production of Coke.—M. Baril: Production of Gas Coke.

Section J: Utilisation of Fuels for Steam Generation and the Production of Electricity.

Ing. F. Siedle: Development of Fuelling Arrangements at the Vienna Municipal Electricity Works.—J. Havlíček: New Experiments with High-Pressure Steam.—V. List: Thermal Central Station in Brno.—H. Th. Bakker: The Combustion of Tertiary Coal on Ships of the Royal Dutch Packet Navigation Co. in the Indian Archipelago.—E. Harprecht: Comprehensive Supervision of Fuel Economy as practised by the German Federal Railway Co.—R. P. Sloan: The Economic Utilisation of Fuels in the Production of Electricity.—Comdr. A. L. P. Mark-Wardlaw: Utilisation of Liquid Fuels for the Generation of Steam.—S. Felsz: The Burning of Polish Coal on Locomotives.—W. Wiśniowski: Estimation of Heat Losses when employing Natural Gas as Boiler Fuel.—S. Kruszewski: Polish Coal as a Fuel for Locomotives.—The Utilisation of Oil Residues as a Fuel for Use in Locomotives.—S. Felsz: Methods employed by the Polish Railways in order to promote Fuel Economy.—T. Sase: Formulæ for the Economical Ratio of Blending Coals for Steam Raising.—M. T. Lindhagen: (*a*) Application of Air-cooled Condensers to Locomotives; (*b*) Experiences with Pre-heated Air for Different Firing Equipment and Different Fuels with regard to Suitable Air Temperature and to Best Total Economy

Section K: Utilisation of Fuels, including Electricity, for Industrial Furnace Work.

Dr. A. Velisek: The Use of Electricity for the Production of Heat in Industrial and Manufacturing Installations.—M. Auclair: Heavy Commercial Vehicles using Producer Gas.—B. Helan: Economic Utilisation of Fuels in the Czechoslovakian Ceramic Industry.—E. Vaněček: Gaseous

Fuels in Czechoslovakia.—O. V. Morch: The Fuel Question in the Cement Industry.—A. van Hoek: Wood Producer Gas for the Treatment of Silver Ores.—Dr. Bansen: Production and Utilisation of Gas in German Iron and Steel Works.—The Use of Producer Gas by the Ashanti Goldfields Corporation.—Sir Robert Hadfield, Bart., and R. J. Sarjant: Industrial Heating by Solid, Liquid, and Gaseous Fuels.—S. E. Monkhouse: Industrial Electric Heating.—Tsunezo Kawasakiya: Thermal Efficiency of an Electric Heating Furnace for Industrial Use.—Yasuzaemon Matsunaga: The Application of Electricity to the Firing of Enamels on Porcelain.—K. Tsujimoto: Industrial and Domestic Uses of Coal.—T. Niemczynowski: Atmospheric-pressure Gas Burners.—Dr. Tsuruo Noda and Taizo Kuroda: Low Grade Coal for Blast Furnace Coke.—Prof. W. E. Groom-Grjimailo and Prof. M. Kirpitscheff: The Hydraulic Theory of the Movement of Gases as applied to the Construction of Furnaces.—T. Lindmark: The Principles of Flame Radiation.—Utilisation of Electricity for Industrial Heating.—Production and Utilisation of Producer Gas in Industry.

Section L: Utilisation of Fuels, including Electricity, for Domestic Purposes.

Dr. A. Velisek: The Use of Electricity for the Production of Heat in Houses, Offices, and Business Premises.—H. Güntner: The Use of Gas for Domestic and Industrial Purposes in Vienna.—E. Dvořák: Utilisation of Solid Fuels for Domestic Purposes in Czechoslovakia.—Dr. Ludwig: Some Considerations regarding the Development of Gas-burning Appliances.—Dr. Margaret Fishenden: A Comparative Study of Solid Fuel, Gas, Electricity, and Oil for Domestic Purposes.—Viscount Shimpei Goto: Electric Heating for Domestic Purposes in Japan.—A. Harlin: Fuel for Domestic Purposes and the Utilisation of Waste Wood in Sweden.—N. Ekwall and O. Stålhane: Electric Hot Plates for Domestic Cooking.—Domestic Heating by means of Solid Fuel, Oil, Gas, and Electricity.

Section M: Pulverised Fuel.

F. Wiesner: Pulverised Fuel Firing in Czechoslovakia.—Dr.-Ing. Förderreuther: Modern Developments in Pulverised Coal Research, and Suggestions for International Co-operation in defining Pulverised Coal Sieves and the Requirements of Coal Pulverisers.—F. H. Rosencrants: Pulverised Fuel Firing.—Dr. W. Lulofs: The Function of the Combustion Chamber of a Powdered Fuel-fired Boiler Installation.—Prof. Shuichi Yamaguchi: Progress of Pulverised Fuel Burning for Steam Boilers in Japan.—Powdered Fuel—Production and Utilisation in the Metallurgical Industry and for Steam Raising.—Prof. L. K. Ramzin: The Combustion of Anthracite Culms and Brown Coals in Pulverised Form.—M. Frion: Production of Pulverised Fuel and its Utilisation in the Metallurgical Industry.

Section N: Internal Combustion Engines.

Ing. M. Gelinek: Electrical Transmission with Heat-driven Vehicles.—Prof. M. Defays: The Present Position of the Use of Heavy Oil for Motor Traction.—A. Buchi: Internal Combustion Engines with Exhaust Turbo-Supercharging.—E. Rackwitz und A. von Philippovich: Evaluation of Fuels used for Aviation in Germany.—Dr.-Ing. W. Riehm: The Present Position of the High-Speed Heavy Oil Automobile Engine.—H. R. Ricardo and O. Thornycroft: Petrol Engines and their Fuels.—H. Moore: Fuel Oil for Heavy Oil Engines.—P. Yanouschevsky: Experiments with Diesel Engine-driven Locomotives on Russian Railways.—Prof. E. Hubendick: (*a*) The Use of Ethyl-Alcohol as a Motor Fuel; (*b*) The Use of Heavy Oils in Internal Combustion Engines.

Section O: Transmission of Power.

Dipl.-Ing. Traenckner: Problems of Long Distance Gas Transmission—The Transmission of Power over Various Distances by the Alternative Methods of the Transport of Coal, the Transport of Oil, the Transmission of Gas, and the Transmission of Electrical Power.—Long Distance Gas Distribution.—V. L. Jones: Legal Aspects of Gas Transmission.

Section P: Waste Heat Recovery.

A Report on 'Waste' Heat Recovery.—Dr. S. Kasai: Waste Heat Recovery in the Japanese Cement Industry.—Waste Heat Recovery, including Utilisation of Waste Furnace Gas, Blast Furnace Gas, Sensible Heat in Waste Coke, Exhaust Gases in Gas Engines, etc.

Section Q: Low Temperature Carbonisation.

Dr.-Ing. P. Rosin: Possibilities for combining Low Temperature Carbonisation with the Generation of Electricity.—Dr. C. H. Lander and Dr. F. S. Sinnatt: Low Temperature Carbonisation.—Dr. R. Heinze: The Present State of Low Temperature Carbonisation in Germany.

Section R: Peat.

Prof. G. Keppeler: Peat Treatment.—N. Testrup and T. Gram: The Drying of Peat.—P. Nomals: Peat Fields in Latvia, and the Use of Peat as a Fuel.—Methods Employed in U.S.S.R. for the Production of Peat.—Peat Combustion Practice in U.S.S.R.—Experimental Work on the Artificial Dehydration of Peat, and its Conversion into Powder and Briquettes.

Section S: Power Alcohol.

M. Loskot: The Use of Power Alcohol in Czechoslovakia.—Col. Sir Frederic L. Nathan: Alcohol for Power Purposes.

Section T: Training of Fuel Technicians.

Prof. W. J. Müller: The Training of Fuel Engineers in Austria.—F. Smal: The Duty of the Fuel Technologist and the Training of the Stoker.—Prof. J. W. Cobb: The Training of Fuel Technicians.

Section V: Organisations concerned with the Efficient Use of Fuel in Industry.

Ing. B. Peča: A Survey of the Scope of Organisations in Czechoslovakia concerned with the Efficient Use of Fuel in Industry.—Dipl.-Ing. F. zur Nedden: Organisations for the Promotion of Fuel and Heat Economy in German Industry.—E. C. Evans: A Survey of the Scope of Organisations concerned with the Efficient Use of Fuel in Industry.—M. I. Lapiroff-Scoblo: General Problems of Fuel Utilisation.

Section W: Economic Possibilities in the Better Co-ordination of Fuel Utilisation.

Fuels in China.—Sir Arthur Duckham: A Fuel Policy.—M. Berthelot: Coal Briquetting and Co-operation between Coke Ovens, Blast Furnaces, and Martin Furnaces.

Section X: Technical Data on Fuel.

Technical Data on Fuel.

SEPTEMBER 25 AND 26.

IRON AND STEEL INSTITUTE (in Assembly Hall, Alfonso XIII. High School, Bilbao, Spain).

Tuesday, Sept. 25, at 10 A.M.—

J. Balzola: Iron Ore Mining in Vizcaya.

J. G. Pearce: The Use and Interpretation of the Transverse Test for Cast Iron.

L. B. Pfeil: The Change in Tensile Strength due to Ageing of Cold-drawn Iron and Steel.

C. A. Edwards and T. Yokoyama: The Influence of Varying Strains and Annealing Temperatures on the Growth of Ferrite Crystals in Mild Steel.

Wednesday, Sept. 26, at 3.30.—

A. Herrero and M. de Zubiria: The Phenomena of Corrosion of Iron and Steel.

J. Orland: The Influence of Pearlitisation below the Ar_1 Point on the Mechanical Properties of Carbon Steels.

J. H. Whiteley: Effects Observed in Quenched Liquid Steel Pellets and their Bearing on Bath Conditions.

S. H. Rees: Some Properties of Cold-drawn and of Heat-treated Steel Wire.

SEPTEMBER 26–29.

PALAONTOLOGISCHE GESELLSCHAFT (at Budapest).

SEPTEMBER 28 AND 29.

FARADAY SOCIETY (in Physical Chemistry Laboratory, University of Cambridge).—General Discussion on Homogeneous Catalysis.

Friday, Sept. 28, from 2.30-4.30 *and* 5-7.15.—

Prof. T. M. Lowry: Introductory Paper. Some Problems in Homogeneous Catalysis.

Part I. General Relations.

C. N. Hinshelwood: Homogeneous Catalysis.

C. H. Gibson and C. N. Hinshelwood: The Influence of Nitrogen Peroxide on the Union of Hydrogen and Oxygen. A Problem of 'Trace Catalysis.'

H. Moureu: Catalytic Phenomena in the Tautomerism of certain α-Diketones.

Dr. E. K. Rideal: Negative Catalysis.

N. R. Dhar: (*a*) Ionisation in Chemical Change; (*b*) Negative Catalysis in Slow and Induced Oxidations.

F. Gill, E. W. J. Mardles, and H. C. Tett: Phosphorescence and Autocatalysis during Slow Combustion.

H. Baeckstroem: Negative Catalysis.

Part II. Intermediate Addition-Compounds and Chain Reactions.

J. Kendall and Lilian E. Harrison: Compound Formation in Ester Water Systems.

J. A. Christiansen: Report on the Theory of Chain Reactions.

M. Polanyi: Bromine Inhibition of Chain Reactions.

J. Boeseken: The Theory of Molecular Dislocation Applied to Homogeneous Catalysis.

Saturday, Sept. 29, 10 A.M.-1 P.M. *and* 2.30-4 P.M.

Part III. Neutral Salt and Activity Effects.

J. N. Brønsted: The Theory of Acid and Basic Catalysis.

Dr. H. M. Dawson: Catalytic Effects of Acids and Bases and the Influence of Inert Salts.

H. von Euler: Compounds between Catalysts and Substrates and their Reactivity.

H. Goldschmidt: On the Catalytic Activity of Hydrogen Ions in Ethyl Alcohol.

H. S. Harned and G. Åkerlöf: Investigations of Salt Action in Homogeneous Catalysis.

F. O. Rice and J. J. Sullivan: Keto-Enol Isomerism and the Mechanism of Homogeneous Reactions.

F. G. Soper: The Activity Theory of Reaction Velocity. The Rate of Interaction of a Chloroamine and Hydrobromic Acid.

OCTOBER 1–3.

INTERNATIONAL FEDERATION OF INTELLECTUAL UNIONS (at Prague).

Oct. 1.

C. P. Blacker: The Modern Conception of the World.—F. Dessauer: Der Geist der Erfindung.

Oct. 2.

H. de Man: Le rôle de la technique dans le domaine social.—A. Fontaine: La transformation d'État sous l'influence de la technique.

Oct. 3.

Jeanneret–Le Corbusier: Les formes nouvelles de l'art protique.—C. G. Jung: Das Seelenproblem des modernen Menschen.

SATURDAY, SEPTEMBER 29, 1928.

CONTENTS.

Our National Collections.[1]

IT is evident that the Royal Commission on National Museums and Galleries has been deeply impressed by the urgency of the needs of these institutions. It has followed the unusual course of publishing an interim report while its deliberations still have to assume their final form. The Commission was appointed by Royal Warrant on June 1, 1927. It consisted of Viscount D'Abernon (chairman), the Hon. Evan E. Charteris, Sir Thomas Heath, Sir Lionel Earle, Sir Richard Glazebrook, Sir George MacDonald, Sir Courtauld Thompson, Sir Martin Conway, Sir Henry A. Miers, and Dr. A. E. Cowley—a strong and representative body, competent to deal with the many sides of a complicated problem.

The terms of reference were indeed wide. They covered the legal position and administration, accommodation, structural condition, and cost of maintenance of nineteen institutions, of which five are Scottish and situated in Edinburgh, while the remainder are in London. The Commission was asked, further, to report on the existing conditions of the collections, their probable rate of growth and consequent increase in expenditure, the possibility of economy and the desirability of imposing admission fees : whether congestion could be relieved by methods other than of building, such as sale, gift or loan, the desirability of change in the Copyright Acts, the question of placing the collections under a central authority, the effect of benefactors' bequests as a restriction on suitable and scientific arrangement and on allocation to appropriate museums ; and, finally, to make suggestions generally which might offer themselves as pertinent in the course of the inquiry.

The Commission, up to the date of the publication of its report, had held twenty-seven meetings and had received evidence orally or by memorandum from the national institutions named in the terms of reference, from a large number of representative societies and institutions, from foreign governments, and from private individuals. A part of this evidence has been printed and is presented in a separate volume simultaneously with the report. Much of the material is of the greatest value, as will become more apparent when the final report, which must deal with a number of controversial questions, has been issued. The interim report deals only with the question of accommodation, present and future—a matter upon which there cannot be two opinions on the main

[1] Royal Commission on National Museums and Galleries. Interim Report. Pp. 64. (London: H.M. Stationery Office, 1928.) 2s. net.

issue, however much difference there may be as to detail.

Before dealing with its main topic the report reviews the national collections as a whole, and recapitulates the history of each. In this connexion two points in particular are stressed—their enormous value and the extent to which the nation is indebted to the private benefactor.

While recognising that financial value represents a narrow point of view, and that any trustworthy estimate of the whole of the national collections is in effect impossible, it is pointed out that one of the smaller London collections alone has been estimated to contain treasures worth £15,000,000. Yet, from the inception of each of these institutions until the present day, the total grants in aid of purchases have not exceeded £5,000,000. As compared with other social services, the growth of these institutions has been severely checked, and economy has been pushed beyond the point of prudent administration. The Commissioners think there has perhaps been a tendency to take the national collections as a matter of course without any attempt to make the public aware of their quality and character. In too many cases they are housed and exhibited unworthily of their dignity and importance.

When the Commission had under consideration the question of accommodation and its relation to the growth of the collections, it was not dealing with a question that had not previously been considered. It is of course generally known that for some time past the large national institutions in the London area have had under consideration schemes for enlargement, involving very considerable expenditure. Both the National Gallery and the National Portrait Gallery have vacant spaces upon which it is proposed ultimately to expand. Elaborate plans have been prepared for the enlargement of the British Museum, and the newspaper section of the library has been removed to Hendon. The Commission has taken these plans into account, but it offers alternative suggestions which, while making provision for expansion for the next fifty years at an estimated cost of £779,000, would effect a saving on the projected schemes of at least £800,000.

The most serious problem is of course the British Museum, and it is to a great extent for this reason that the Commission has been asked to advise on the desirability of alteration of the Copyright Acts. It is estimated that additions to the British Museum Library involve the provision of one mile of shelving per annum. The Commissioners are fully alive to the danger of one suggestion, namely, that not all accessions should be preserved: they point out that not only is it difficult to decide that any individual item is not likely to be required, but also the task of selection would require a skilled staff which would absorb the proceeds of any economies thus effected.

One problem connected with the British Museum, which from an imperial point of view is even more serious, obtains merely an incidental reference in the interim report, and is left for fuller consideration later. This is the question of the ethnographical collections. The Commission quotes with approval from the Memorandum of the Council of the Royal Anthropological Institute, in which is emphasised "the fact that the present position of ethnography in the National Museums of London is a grave reproach to our standing among other nations," and it is further remarked that "this subject is given less attention in the capital city of the British Empire than it is in countries which have far fewer responsibilities or even none at all towards uncivilised or alien peoples."

This question is one upon which much could be said, and, in view of the public interest likely to be aroused by this report, one upon which more perhaps should have been said at this stage. The provision of an adequate imperial ethnographical museum is largely a matter of arrangement and of the space which such arrangement requires. We have ample material for initiating such a museum, and although the time has passed when specimens of the material culture of primitive peoples could be bought for a song, it is still possible to add to our collections and to fill gaps at no excessive cost. Nor is it desirable that these collections should be regarded solely as an exhibition demonstrating the curious customs of primitive peoples or as material for the research student. The public should be made to realise that it is not merely an academic question that in London, at any rate, there is no adequate museum for practical demonstration in the teaching of anthropology—a subject which is essential for the training of the young administrator who will be sent out to govern the peoples in the different parts of the Empire whose culture is exemplified in the British collections. The cost of providing such a museum will be heavy; but it must be faced.

The report deals with the needs of the Natural History, Science, and Geological Museums, but its recommendations as to these institutions must be reserved for consideration in a further article.

Intelligible Philosophy.

The Analysis of Matter. By Bertrand Russell. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii + 408. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1927.) 21*s.* net.

An Outline of Philosophy. By Bertrand Russell. Pp. vi + 317. (London: George Allen and Unwin, Ltd., 1927.) 12*s.* 6*d.* net.

The Nature of Existence. By Dr. John McTaggart Ellis McTaggart. Vol. 2. Edited by Dr. C. D. Broad. Pp. xlvii + 480. (Cambridge: At the University Press, 1927.) 30*s.* net.

MR. RUSSELL'S books are always a pleasure to read, perhaps because they have been a pleasure to write. The "Outline of Philosophy" is even pleasanter than most of his philosophical works, and gives also the completest account of his views. A considerable part is essentially a summary of the "Analysis of Matter" and also of the "Analysis of Mind" published a few years ago. On the whole, the summarising process has been an improvement; though some valuable discussion of recent physical theory is to be found only in the "Analysis of Matter."

Mr. Russell follows the British tradition; his method of approach to problems is like the "plain historical method" of Locke. He starts by asking, What is man considered from the outside, as an organism capable of perceiving and acquiring knowledge about his environment? Then he considers the general character of that knowledge, that is to say, the conceptions of theoretical physics. Lastly, he returns to the study of the human mind, but considered this time from inside, asking, What is it like for me to perceive and have knowledge about my environment?

Mr. Russell seems at his best when he is most insular, and least happy when he seeks inspiration across the Atlantic. The discussion, in the first part of the book, of the working of the mind from the behaviourist point of view, might have been better had he been concerned less exclusively with Prof. J. B. Watson's views. This may be a minor point; the trouble seems more serious when he comes to his main conclusion, to which he gives the name 'neutral monism' and which he says originated with certain recent philosophers of Cambridge, Mass. The conclusion, put briefly and crudely, is this. Modern developments of physics have eliminated the mechanical universe of matter in motion assumed in scientific tradition since Descartes. In its place we have a universe of 'events,' of spatio-temporal durations, out of the abstract relations of which scientific knowledge is constructed. Physics tell us about certain logical characteristics of structure belonging to the constituents of the physical world, but nothing about their intrinsic character, which might be anything. On the other hand, in sense experience what we are aware of are just mental events. Starting from opposite ends, theoretical physics and introspective psychology reveal as primary only physical events and mental events; two sets which form a causally connected whole. There is no reason, Mr. Russell says, to suppose that the two sets are really quite distinct. What we call mental and what we call physical may be two ways of speaking about one sort of stuff which is neither one nor the other, but 'neutral.'

This 'neutrality' savours rather of the neutrality of nations whose neighbours are at war. It is likely to be weighted on the mental side, which on this theory has a certain priority, since it is all we are immediately acquainted with. The physical world, according to Mr. Russell's confession, is a precarious inference from experience. He admits that his belief in it and his repudiation of solipsism are based solely upon animal faith. The theory, though doubtless ably supported by Harvard, is astonishingly like one that appeared nearer at home, at Trinity College, Dublin, two hundred years ago. It is Berkeley's theory without God, an omission the good Bishop would have deplored. Nevertheless, if Berkeley was wrong, Mr. Russell can scarcely be right, and he need not look to his Bostonian friends for help. It is possible that they are all of them right (where they agree); and if they err, undoubtedly they err in good company.

Mr. Russell differs from Berkeley in important respects, notably those on which he bases his claim to neutrality. It is here that the gravest difficulties appear. To take one point, he says:

"When we have a percept, just what we perceive (if we avoid avoidable sources of error) is an event occupying part of the region which for physics is occupied by the brain." Seeing a green leaf "consists of the existence in the region occupied by our brain of a green patch causally connected with the leaf, or rather with a series of events emanating from the place in physical space where physics places the leaf. The percept is one of this series of events differing from the others in its effects owing to the peculiarities of the region in which it occurs—or perhaps it would be more correct to say that the different effects *are* the peculiarities of the region." ("Outline," p. 292.)

An obvious difficulty is the location of a percept in physical space. Physical space is presumably a logical construction, constructed from perceptual spaces which consist of perceptual events and their relations; therefore assertions about location in physical space are of a different logical type from assertions about the locations of percepts in perceptual space. At first sight, then, the statement that a percept is anywhere in physical space seems to be merely a metaphor; just as it is a metaphor to say I have money in the bank if I use the words in the sense in which I say literally that I have money in my pocket. The difficulty may possibly be purely verbal, but even if it is, a correct form of statement is needed.

A further difficulty suggests itself. If a perceptual event is located in physical space, why is the brain specially privileged to be its situation? The relevant physical process consists of the whole causal series of events beginning with those emanating from the place where the object is and going on to a practically endless series of events in the body of which the contemporary events in the brain are only a part and are seldom if ever the last terms, for the whole bodily reaction must be included in the series. When we see a green leaf bodily reaction is not conspicuous, and Mr. Russell's statement is plausible. If he substituted a tiger, the defects of his treatment could be seen. In ordinary speech, we say we run away because we see a tiger; it would be more correct to say we see a tiger because (among other things) we run away. If the green patch we see, or the striped patch if it is a tiger, can be said to be in the brain, may it not equally well be said to be in the whole spatio-temporal volume of causally related events both inside and outside the body? Mr. Russell makes a suggestion ("Analysis," p. 259) that might lead to a view of this sort, but does not develop it. The problems raised by Mr. Russell cannot, of course, be properly discussed here, but perhaps enough has been said to show that his treatment is, as is usual with him, both novel and interesting.

The late Dr. McTaggart's book is the second volume of his chief philosophical work, left in a state very near completion at his untimely death. His philosophy is likely to appear as 'caviare to the general,' but some will appreciate his curiously individual and compact system of thought. Many more will appreciate his vigorous but sympathetic criticism of the views of others. Dr. McTaggart's development of his theory has something of the character of Greek tragedy, fantastic as seen from outside its circle of ideas, but inevitable as seen from within. His style is admirable, dry but clear. From his editor we learn that he always made five complete drafts of his work before considering it ready for publication. *O, si sic omnes!*

A. D. R.

Strength of Materials.

(1) *Strength of Materials: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A.M.I.C.E., and A.M.I.Mech.E. Examinations in this Subject.* By Dr. F. V. Warnock. (Engineering Degree Series.) Pp. ix + 366. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 12*s*. 6*d*. net.

(2) *Mechanics of Materials.* By Prof. George Young, Jr., and Prof. Hubert Eugene Baxter. (Engineering Science Series.) Pp. viii + 451. (New York: The Macmillan Co., 1927.) 17*s*. net.

(3) *Examples in the Strength and Elasticity of Materials.* By G. W. Bird. Pp. 196. (London: Edward Arnold and Co., 1927.) 10*s*. 6*d*. net.

THE study of the strength of materials, based on one hand upon the ideal theories of elasticity and, on the other, upon experimental data, is a growth of the last hundred and fifty years. Galileo, in the sixteenth century, made experiments upon beams and deduced a theory of the stresses due to bending, which gave a formula for a rectangular beam correct in form but incorrect so far as the constants were concerned, due to a false assumption as to the position of the neutral axis. It was not until 1825 that Navier gave the correct solution of the distribution of stress in a beam subjected to bending, his solution being based upon Hooke's Law and on the justifiable assumption that the sum of all the forces upon any section in equilibrium must be equal to zero. At the end of the eighteenth and the beginning of the nineteenth century, experimental research supplemented theory, and during the last hundred years a great body of knowledge has been accumulated upon a subject of importance to engineering in all its branches, as well as to building and architecture, and, to-day, perhaps no one subject is studied by a greater number of technical students than that of the strength of materials.

The three books which are now under consideration illustrate the wideness of the appeal. The first has been "written for Engineering Students," the author of the second has apparently had in view "those students of Engineering, Building and Architecture" who will be concerned with the design of structures, while the third, as its title

indicates, confines itself to worked examples based upon syllabuses of instruction of certain examining bodies.

(1) The first fourteen chapters of the volume by Dr. Warnock deal with the subjects that most teachers treat in an advanced evening class or in the second year, and perhaps part of the third year, of a university course. So far as we have been able to see, there is no new point of view presented, and it would be easy to mention subjects of considerable importance that are not dealt with at all. For example, the chapter on the torsion of shafts does not refer to torsional oscillation, and does not therefore deal with the time of oscillation of a spring. St. Venant's theory for rectangular and square shafts is referred to, and formulæ quoted, but no attempt has been made to give the theory; it is doubtful how far it is desirable in such a book merely to quote formulæ. The last chapter is devoted to a description of some of the more elementary apparatus found in a strength of materials laboratory. There is also given a summary of formulæ. There are well-selected examples attached to each chapter, often taken from examination papers.

(2) The volume by Messrs. Young and Baxter is even more elementary than the first volume, and commences by asking the student to work certain elementary arithmetical problems, evidently with the admirable intention of emphasising method, neatness, accuracy, and care in units. The first five chapters deal with elementary statics, a considerable number of simple types of structures being considered, and as examples for the student.

After dealing with centre of gravity, the author proceeds to consider unit stresses, and some of the characteristic properties of materials. In this connexion weathering, æsthetic qualities, cost and availability as factors in design are referred to briefly. Then follows a chapter on investigation, safe load and design, and in this chapter simple riveted joints are considered. Forces and stresses are returned to, and moments of inertia for simple areas are determined. The theory of beams and columns is then dealt with in ten chapters, one of which treats of "combined materials," including the elements of reinforced concrete theory; and another with unsymmetric bending. The last two chapters deal with miscellaneous problems and special graphic methods. The notation used is summarised at the end of the book, and there are appendices giving formulæ and a number of special bending-moment diagrams for beams.

The book is written clearly, and emphasises considerations other than those covered by mathematical theory. It should prove useful and interesting to elementary students of structural engineering and to architects. It scarcely goes far enough for advanced work in a technical school or a university course.

(3) The third volume calls for very little comment. The examples solved are representative, and no doubt will be very helpful to many students working for examinations.

British Butterflies and Moths.

A Revised Handbook of British Lepidoptera. By Edward Meyrick. Pp. vi + 914. (London: Watkins and Doncaster, 1928.) 18*s*.

MORE than a generation has elapsed since a new and comprehensive treatise on our British butterflies and moths, on highly original lines, was submitted to the entomologists of the period by a well-known worker in the field of the Micro-Lepidoptera. The sensation caused by the daring innovations in classification and nomenclature in Mr. Meyrick's first "Handbook"—now long out-of-print—and the mixed reception accorded to the book by the leading authorities of the time, are still fresh in the memory of many of our living lepidopterists. In the words of the notice which appeared in NATURE (vol. 53, p. 265) soon after its publication: "Every one who knows our British Lepidoptera will recognise the sweeping character of the changes proposed, and how far they will ultimately be accepted no one can venture to predict at present." The complete upsetting of all previous arrangements of this order of insects by a quasi-Linnean system of classification, and the revolutionary changes of the names in current use of so many of our most familiar species, were by no means generally welcomed or readily adopted; and in this connexion it is significant that, so far as the experience of the present writer is concerned, it is still very rarely that we meet with a public or private collection of Macro-Lepidoptera arranged on the system of the "Handbook."

The only practical treatise on the British Lepidoptera as a whole, in the hands of entomologists at the time of the publication of Mr. Meyrick's original "Handbook," was the well-known "Manual" of Mr. H. T. Stainton, a work then nearly fifty years old, and naturally in many respects out-of-date. Even at the present time, however,

the old "Manual" is regarded almost with veneration by the veterans of British entomology whom it served so well in the early days of their studies, and it yet retains much of its value as an introductory text-book for those young entomologists whom its esteemed author loved to call "incipients."

It was therefore with not unmixed feelings that the new work was adopted, but in spite of its many innovations and their attendant difficulties, it was not long before it was recognised by the more scientific section of our lepidopterists as embodying in very many respects a distinct advance on all preceding treatises of its kind. As it was based not merely on the consideration of a limited insular fauna, but on that of the Lepidoptera of the whole world, and throughout emphasised the paramount importance in classification of structural detail, though in the main it relied almost entirely on the single character of neuration, it was recognised by one of the foremost lepidopterists of the time as being "without exception the best class book that has yet appeared for imparting real sound knowledge of structure, evolution, and classification."[1]

In the present revised form of the "Handbook" the introduction has been largely rewritten and extended, and while the phylogenetic diagrams in the former volume have been entirely dispensed with, the very ingenious and convincing simile (p. 12) of the evolutionary scheme of classification into which the element of time is introduced as a fourth dimension, will be duly appreciated as a distinct advance on previous conceptions of this subject. The descriptions of about a hundred species which have been added to the list of our fauna in the interval between the two editions of the work are duly included in their order, and a few have been suppressed for various reasons, thus bringing the number of recognised British Lepidoptera up to a total of 2143 species, a net increase of about eighty since the 'census' of 1895.

Among the (so-called) Macro-Lepidoptera, considerable changes of detail have been effected, and two new 'phyla'—an unfortunate term in this connexion, as it has long been in use among zoologists for the major divisions of the animal kingdom—have been introduced. The separation of the Hesperiana from the Papilionina and their elevation to equal rank, as well as that of the Drepanina to a distinct 'phyletic' group, are in accordance with the most recent views on classification. In the butterflies, which are now sandwiched between the Notodontina and the Drepanina, we still find the arrangement of certain sections unconvincing to those who regard them from the points of view of life-history, habit, and structure as a whole. Thus in the Lycænidæ, the 'Little Blue' is yet found rubbing shoulders with the 'Large Copper' in the genus *Chrysophanus*; and an equally unconvincing medley of species, differing widely *inter se* in almost all respects, is presented in—as we prefer to call them—the 'Noctuid' genera *Caradrina*, *Polia*, and *Melanchra*, to say nothing of a good many others. The old 'Geometrina,' included as before in the 'phylum' Notodontina, have undergone extensive rearrangement in accordance with modern views, and the Pyralidina are now followed by the Lasiocampina, which includes the very isolated genus *Endromis*.

The work is, however, seen to greatest advantage in the Tortricina (from which *Trypanus cossus* has now been removed to the Psychina beside its evident ally *Zeuzera æsculi*) and especially in the Tineina. In these two groups, and notably in the latter, the author of the "Handbook" has for many years been recognised as *facile princeps* the highest authority, and the section dealing with the Tineina has been entirely recast in the light of his unrivalled knowledge and experience. The number of Tineid families has been increased from 6 to no fewer than 21, and an outstanding though desirable innovation is the separation of the Nepticulidæ and their elevation to 'phyletic' status.

In the preface the author gratefully acknowledges his indebtedness to the late J. Hartley Durrant, whose recent death all entomologists deplore, and to Prof. E. G. R. Waters, of Oxford, who is now well known as one of the most energetic and capable of our younger micro-lepidopterists.

The printing and general style of the work, as was the case with its predecessor, leave little or nothing to be desired, and, so far as we have seen, errata and misprints, so difficult to avoid in a book of its kind, are practically non-existent. While the views of the author on the subjects of classification and nomenclature remain matters for keen discussion, the "Revised Handbook" will for many years to come hold its place as a sound and trustworthy means of identification of our British Lepidoptera, and an invaluable aid to the scientific study of this order of insects.

W. T. W.

[1] Lord Walsingham, *Entom. Monthly Mag.*, 31, p. 284; 1895.

Chemical Facts and Phraseology.

Chemical Encyclopædia: an Epitomised Digest of Chemistry and its Industrial Applications. By C. T. Kingzett. Fourth edition. Pp. viii + 807. (London: Baillière, Tindall and Cox, 1928.) 35*s.* net.

THE subject of chemistry increases by leaps and bounds, not only owing to the continual discovery of new inorganic and organic substances, but also because of the introduction into the science of novel conceptions and ideas involving in many cases a new and highly technical terminology. Readers of current memoirs on chemical research often feel the need for a glossary of chemical terms owing to the rapidity with which the language of chemistry is changing. To the non-technical reader much of this literature appears to be a jargon which becomes ever less intelligible, but since chemistry has an educational aspect as well as many important industrial applications, it remains desirable that non-scientific members of the community should not be entirely ignorant of chemical facts and phraseology.

The veteran author of the "Chemical Encyclopædia," who as one of the original founders of the Institute of Chemistry did much to standardise the chemical profession in the early days, has striven with conspicuous success to compile an epitomised digest of pure and applied chemistry, this epitome being now in its fourth edition. At the outset this work, which then bore the title of "The Popular Chemical Dictionary," owed its origin to the circumstance that early in his career the author realised that the future welfare of the British Empire depends in the main on increased production within its boundaries by the utilisation of its boundless natural resources. Success along this line can only be attained by increased teaching and intensive application of chemical science. In presenting this enlarged and revised edition of his encyclopædia, the author contributes anew to the enlightenment of the public as regards the more salient topics of chemistry.

The work is much more than a dictionary of chemical terms, for in many instances important headings are expanded into concise essays. The first of these essays in alphabetical order is entitled "Alcohols" and occupies four pages. It is followed shortly by a discussion of alloys which fills three pages. In both instances the data supplied are informative and up-to-date. The study of colloids has been greatly extended during recent years, and the article "Colloid Chemistry" (5 pages), which summarises progress in this direction, includes a bibliography of relevant treatises. Each chemical element receives notice, the reference being proportional in length to the industrial importance of the element and its derivatives. Many subjects of outstanding interest, such as cellulose, dyes and dyeing, isotopes, lead tetra-ethyl, motor spirit, perfumes, poisons and antidotes, sugar, tar, and vitamins, are discussed.

Despite its wide scope, the book is remarkably free from errors and obscurities, and such as are encountered are readily recognised to be misprints. The author has exercised considerable discrimination in the selection of topics, and within a handy compass he has compressed a vast store of useful chemical information presented in a very attractive and readable form. Throughout the volume there are copious references to larger treatises and to original memoirs, so that in most cases the sources of more specialised knowledge are indicated.

The present edition is much larger and more comprehensive than the earlier ones, and should appeal not only to the professional chemist, but also to all who require a convenient desk book of information regarding chemistry and its industrial applications.

G. T. M.

Biological Assay of Drugs.

Methods of Biological Assay. By Dr. J. H. Burn. (Oxford Medical Publications.) Pp. xvii + 126. (London: Oxford University Press, 1928.) 8*s.* 6*d.* net.

THE attention which has been directed during recent years to the determination of the potency of drugs for which no method of chemical analysis is at present available has necessitated both the introduction of new, or the adaptation of older, methods of biological assay as well as the preparation of stable standards of reference in terms of which the activity of the samples tested may be expressed. The importance of the accurate standardisation of a drug was shown when insulin was introduced into clinical therapeutics, and the work of the Health Section of the League of Nations and the passage of the Therapeutic Substances Act (1925) have directed further general attention to this subject.

The appearance of Dr. Burn's book at this moment is therefore most opportune, and its usefulness is enhanced by the fact that the author has strictly limited himself to the details of methods with which he is personally familiar. Thus, any worker unused to assaying a particular drug will

find at hand one or more well-tried methods by means of which he can, with any reasonable degree of skill, obtain a fairly accurate result. It is probable that in certain cases other workers will not agree with all the details of the methods as detailed by Dr. Burn; for example, the reduction in the height of the contraction of the rabbit's uterine strip to adrenalin, following a dose of ergotoxine, is taken as the endpoint, instead of the complete abolition of the adrenalin contraction, as some workers prefer; and in the assay of insulin by the method of the reduction of the blood-sugar of rabbits, the accuracy of the test is probably enhanced if more than six animals can be used.

Methods for the following drugs are given: digitalis, strophanthus and squill, pituitary (posterior lobe) extract, insulin, arsenobenzene, ergot, adrenalin, œstrin, the parathyroid hormone, histamine, atropine, and antipyretics. Wherever possible the account of the method is preceded by a note on the standard preparation for the drug in question; an omission is the definition of the unit of pituitary extract, which will doubtless be rectified in a new edition.

An introduction has been written by Dr. Dale; it should be read by all interested in the subject, since it emphasises the necessity of accurate standardisation when drugs are to be used on human beings—who show great variations in their individual reactions—and also the errors into which workers may fall. Dr. Burn concludes his book with a chapter on the accuracy to be expected from methods of biological assay and refers to the means of gauging the accuracy of any particular result. This is a most useful little book; although chiefly for the specialist, it can be read with profit by all those who take an interest in knowing how the potency of certain of the remedies they use can be kept within certain unvarying and fairly narrow limits.

Our Bookshelf.

Handbuch der Vererbungswissenschaft. Herausgegeben von E. Baur und M. Hartmann. Lieferung 4, Band 2. *Das Inzuchtproblem.* Von Harry Federley. *Selbststerilität, Heterostylie.* Von E. Lehmann. Pp. ii + 42 + ii + 43. (Berlin: Gebrüder Borntraeger, 1928.) 5·80 gold marks.

THE importance of inbreeding to practical breeders of plants and animals is well emphasised in this part of the valuable "Handbuch der Vererbungswissenschaft." The subject is considered from six aspects: as a mathematical problem, experimental research on animals, inbreeding amongst plants, heterosis and hybrid vigour, inbreeding and sterility, and the advantages and disadvantages of inbreeding. The chief advantage of inbreeding is the speedy elimination, by selection, of undesirable recessive genes from the inbred population. Correspondingly, the main disadvantage is the reduction and, except for the possibility of mutations, final prevention of 'variation' by the production of new gene combinations.

The subject of self-sterility is one of increasing interest, since we now know that it has a wide distribution amongst plants and is recorded for the animal kingdom. The present summary is a useful, but too brief, account in which the following matters are considered: the historical aspect, the taxonomic distribution, its relationships with self-fertility, and its different causes, determined or possible. It is, however, emphasised that much more research work must be done before generalisations are possible.

Dimorphic heterostylism is best known in the genus *Primula*, and genetical studies have been made in several species. It also occurs in other Primulaceæ (as in *Hottonia*), in *Forsythia*, *Pulmonaria*, *Fagopyrum*, and *Linum*. Trimorphic heterostylism has been studied in *Lythrum* and *Oxalis*. In both kinds the long-styled condition is, in known examples, recessive. In *Lythrum* the trimorphic development of the reproductive organs is genetically explicable by using the trihybrid ratio, two recessive factors giving long, one recessive mean length, the other recessive short styles. With the appearance of homostyle plants among primulas, it has been found necessary to postulate two independent factors as a genetical explanation of the positions of stigma and stamens in this genus also.

Brachiopod Morphology and Genera (Recent and Tertiary). By Dr. J. Allan Thomson. (New Zealand Board of Science and Art, Manual No. 7.) Pp. vi + 338 + 2 plates. (Wellington, N.Z.: Government Printer; London: High Commissioner for New Zealand, 1927.) 17*s*.

IT is greatly to be regretted that, owing to the death of the author, the present volume must be the last of a series of publications which were the outcome of many years' research on Tertiary and Recent Brachiopoda, more especially those of Australia and New Zealand. The volume includes a detailed description of the morphology of the Brachiopoda, as well as a complete list of all known Tertiary and Recent species, with notes on their distribution. In addition there are careful diagnoses of all the genera, illustrated by numerous diagrams showing the various stages of loop-development.

A new classification is proposed for the Brachiopoda, which the author divides into two new subclasses, Gastrocaulia and Pygocaulia, the former to include the primitive, horny forms, and the latter the more highly evolved calcareous, hinged forms. These divisions are based very largely on the embryonic development of the Brachiopoda. Beecher's classification into four orders is slightly emended; the Atremata and Neotremata are placed in the Gastrocaulia, and the Protremata

and Telotremata, together with a new order, Palæotremata, are placed in the Pygocaulia. The Telotremata are said to be derived from the Gastrocaulia through the Palæotremata and the Protremata, the former order including primitive, calcareous forms lacking articulation. Beecher, on the other hand, claimed that the Protremata were derived from the Neotremata, and that the Telotremata were derived from the Atremata. Further corroboration from the study of living Brachiopoda is required before this classification can be generally adopted.

The volume contains a list of papers dealing with the Brachiopoda of different regions, and it should prove a useful book of reference, not only to the specialist, but also to the student of zoology. Considering the somewhat high price of the book, it is regrettable that the two plates have been printed back to back, and that their reproduction is not more distinct.

The Essentials of Transformer Practice: Theory, Design, and Operation. By Emerson G. Reed. Second edition, revised and enlarged. Pp. xii + 401. (London: Chapman and Hall, Ltd., 1927.) 21*s.* net.

THE maximum temperature rise of the conductors and of the insulating materials in electrical apparatus when working is usually the factor which determines their capacity. Electrical engineers, therefore, have had to study closely the theory of heat. Serious research in this direction began about twenty-five years ago, and the volume of work goes on increasing every year. There are now several well-known formulæ in connexion with the heating of buried cables which are used in practical design.

These researches have been successful in saving manufacturers many hundreds of thousands of pounds every year. Glazebrook, Russell, and others were pioneers in this direction. Most of the important problems had been already solved more than a hundred years ago in Fourier's work on the theory of the conduction of heat, one of the most brilliant books ever written. It is somewhat of a shock to find, therefore, that electrical engineers (p. 184) seem to think that the temperature rise is based on "Ohm's law for heat." This is stated to be that the resultant heat flow expressed in watts is equal to the temperature rise divided by the thermal resistivity. It is not easy to see what connexion Ohm has with this law. Numerical values of the thermal resistance are given, and also of the thermal resistivity, but it is not quite clear in what units these are measured.

The ever-growing demand for electrical energy has now made it necessary to use very high voltages. Much research, therefore, has been carried out on the brush discharges which take place from overhead cables (generally called the corona) and on the methods of grading underground cables so as to enable them to resist very high pressures. A good and interesting account of some of these researches is given in this volume. The many types of apparatus and the special devices used for obviating dangerous current and pressure rises are well described. We can recommend this book for advanced students at technical colleges and universities.

Erblichkeitsforschung an Pflanzen: ein Abriss ihrer Entwicklung in den letzten 15 Jahren. Von Prof. Dr. Friedrich Oehlkers. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 18.) Pp. viii + 203. (Dresden und Leipzig: Theodor Steinkopff, 1927.) 13 gold marks.

THE subject of inheritance is growing so rapidly that text-books dealing with it are not only in constant need of revision but also can scarcely cover the ground, in an adequate manner, in one volume. There is therefore an increasing tendency to compile more specialised text-books than formerly. Thus the present work deals with recent advances in the study of inheritance in plants. A brief summary of Mendel's work is followed by a concise account of modern research under the headings: stages of development, nucleus and inheritance, chromosomes and inheritance, Morgan's theory (of linkage and crossing over) in botany, protoplasm and inheritance, sterility and lethality, sexuality, and research on mutations. The section on sterility and lethality is especially useful, as this subject is rarely treated adequately in works on inheritance. The author keeps strictly to his subject of plant-life, but usefully directs attention to the difficulties of correlating some of the conclusions reached by geneticists working on animal life with facts emerging from plant breeding.

New Zealand Empididæ: based on Material in the British Museum (Natural History). By J. E. Collin. Pp. viii + 110. (London: British Museum (Natural History), 1928.) 7*s.* 6*d.*

THIS work is a specialised monograph on species of flies of the family Empididæ and is based largely upon extensive collections made in New Zealand by Mr. T. R. Harris, who presented the specimens to the British Museum. Material from other private collectors has also been drawn upon, and the result of Mr. Collin's study of these several collections is to raise the number of known New Zealand species of the family from 23 to a total of 102. This, indeed, is a very satisfactory result, and indicates how much there still remains to be done before the Diptera of that country are adequately known.

In view of the remarkable and archaic elements found in the New Zealand fauna, it appeared likely that the smaller Diptera would yield species of considerable interest and importance. This has evidently proved to be the case, particularly with respect to the discovery of seven genera of Empididæ, previously only known from South America. Mr. Collin is to be congratulated on the evident care and thoroughness with which he has carried out his task. Like all British Museum publications, the book is well printed and clearly illustrated.
A. D. I.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Neanderthal Man and the Natives of New Caledonia.

THE following observations seem to me to be of considerable interest in connexion with the genealogy of fossil types of men. So far back as 1923 I had photographed, side by side, the mandible of an Australian aboriginal, in the Anatomy Department of the University of Sydney, and a cast of the Heidelberg mandible. My object was to show the almost exact correspondence in size and shape of the teeth; in each case the tooth arches were extraordinarily alike in very many respects, but as at that time I could find no example of an Australian or other mandible of modern man which approached the ramus of the Heidelberg jaw in size and general shape, I let the matter stand.

Recently, however, while engaged in work with some of my students upon the distribution of Australoid types in Melanesia, we had occasion to examine Sarasin's recent work (1922) upon the inhabitants of New Caledonia and Loyalty Islands, and we found that Sarasin figured at least two mandibles in which the rami were only 3 mm. smaller in breadth than was the case in the Heidelberg jaw. One of these mandibles (No. 58) also had a relatively shallow mandibular

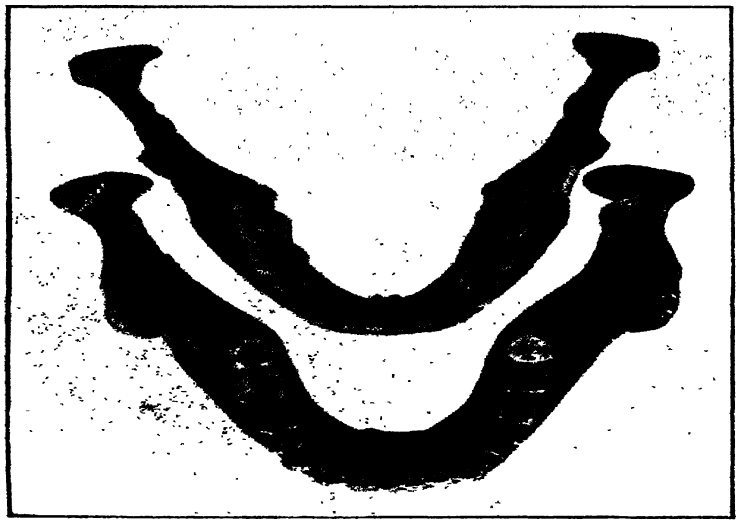

FIG. 1.—Mandible of an Australian aboriginal (No. 179, Anatomy Department, University of Sydney) (upper figure) and a cast of the Heidelberg mandible (lower figure). The dental arches, and even the proportions of individual teeth, will be seen to be almost identical in shape.

notch, though this apparently was not so shallow as that of Heidelberg man; also, in the Heidelberg jaw, more of the 3rd molar was hidden than in the lateral view of the second of these mandibles (No. 197).

In other mandibles figured by Sarasin, however, the same degree of exposure of the last molar tooth is to be seen. Further, Prof. Arthur Thomson in 1915 (*Jour. Anat.*, vol. 50), in discussing certain peculiarities of the human and anthropoid mandible, figured in plate 1 the jaw of a New Caledonian, marked 1118 R.C.S., in which the chin is very receding although not quite to the same degree as in the Heidelberg jaw. Also, the cross-section at the symphysis region (as figured by Thomson in this New Caledonian jaw) shows a considerable similarity to that figured by Schoetensack for the Heidelberg mandible.

FIG. 2.—Norma lateralis of the mandible of a native of the Loyalty Islands (upper figure) (No. 197 of Sarasin's "Anthropologie der Neu-Caledonier und Loyalty-Insulaner") and of a cast of the Heidelberg mandible (lower figure). The proportions of the rami are very similar, although the recession of the chin is not very marked in Sarasin's specimen.

Again, in the chin and symphysis region, we find that Sarasin figures certain New Caledonian and Loyalty Island mandibles which approach the Heidelberg mandible very closely, both in the recession of the chin and general proportions.

A detailed comparison of other measurements taken from Sarasin ("Atlas zur Anthropologie der Neu-Caledonier und Loyalty-Insulaner," pp. 289-312) and Schoetensack ("Der Unterkiefer des *Homo Heidelbergensis*") shows that, in practically all measurements, individual mandibles of New Caledonians or Loyalty Islanders frequently approach or even exceed in size and proportions those of the Heidelberg jaw. For example, the intercondylar breadth in five male New Caledonian skulls exceeded that of the Heidelberg jaw; the same was true of the intergonial breadth.

We have already directed attention to the breadth of the ramus which is the outstanding feature of the Heidelberg jaw. In two cases, New Caledonian and Loyalty Islander, mandibles approach to within 2 or

3 mm. of the same measurement of the Heidelberg jaw, and further, the proportional height-breadth index of the ramus is frequently equalled, or the ramus may become even more squat in New Caledonians.

The condyle of the ramus presents no special feature in the Heidelberg jaw; the one feature which possibly may be primitive, namely, the great antero-posterior size of the condyle and proportional rounding especially of the left condyle, is not frequent in modern mandibles but can occasionally be found.

From a detailed consideration of the symphysis region in all its aspects, it has already been shown that occasional individuals amongst the New Caledonians may very closely approximate to the condition seen in Heidelberg man.

It will thus be seen that while the individual to whom the Heidelberg jaw belonged may possibly, and even probably, have been of a very primitive type, and his skull to have resembled those of the Neanderthal race or that of Rhodesian man, nevertheless such an assumption is by no means fully justified when we find occasionally members of a relatively large-brained modern race of mankind possessing a mandible which closely approximates to the Heidelberg mandible. These New Caledonian natives have presumably a modern type of brain and a large brain capacity (1410 c.c. in the male) and, so far as we are aware, are capable of speech and other activities, and yet their mandible can in occasional individuals closely approximate to the Heidelberg.

There are several features of interest which arise from a critical examination of Sarasin's work, which we are at present engaged in studying, particularly the pathway of migration of these New Caledonians, and of Australoid types from presumably an Asiatic centre, and also the distribution of the Australoid type. Sarasin combines the Australians and these New Caledonians and other groups in a single group—the Austro-Melanesian, which seemed to us to contain several sub-types; among these are two very distinct sub-types, the pure Australoid form with a relatively poorly developed ramus to the mandible and a smaller average brain capacity, and a New Caledonian sub-type with a more powerfully developed mandible especially as regards its ramus, and a larger brain. This latter sub-type had also, possibly, a longer face.

It will thus be seen that in three important characters, namely, the absolute size, the general type of the tooth arch, the size and shape of the ramus, and the shape of the chin, parallels can be found in living races of mankind, and the possessor of the Heidelberg jaw. This close agreement is most especially marked in the case of the New Caledonian and Loyalty Island natives. It is obvious, of course, that these close parallels are not found amongst all New Caledonians but only amongst occasional individuals who possess these characters which we may to some extent designate as 'primitive.'

In conclusion, therefore, it may be reiterated that any statement concerning the primitive characters of the possessor of the Heidelberg mandible should be very guarded, and it by no means necessarily follows that the remainder of his skull resembled that of a member of the Neanderthal race of *Homo Rhodesiensis*. On the contrary, the evidence put forward here, based chiefly upon Sarasin's observations, shows clearly that the skull of Heidelberg man might have been of a relatively modern form, and the brain of its possessor been similar to that of a New Caledonian of the present day.

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X-Ray Studies of the Structure of Quenched Carbon Steel.

CERTAIN investigators [1] have found in quenched carbon steel a body-centred tetragonal structure with the ratio of the axes c/a, 1·03-1·06, depending upon the carbon content. In the paper "Die Theorie der Stahlhartung" Honda [2] states that he and Sekito have investigated in quenched carbon steel a body-centred tetragonal structure with the constant ratio of axes c/a 1·04 independent of the carbon content. The above-mentioned structure was observed by Honda only on the surface of the specimens, whilst they had within the cubical structure, where the length of the edge was increasing with the increase of the carbon content.

We have explored by X-ray analysis a great number of specimens of carbon steel with the carbon content 0·64–1·44 per cent, the largest dimension of the specimen being 10 × 10 × 15 mm. with the temperature of the quenching 1000°-1100°; the steel containing 1·03 per cent of carbon had the initial temperature 900°-1300°, and the steel containing 0·91 per cent of carbon, 775°-1200°. The quenching was carried out as follows: the specimen was drawn all at once from the salt bath and was immediately dipped into the cooling agent (water, hot water, oil).

TABLE I.

% C.	c/a.	% C.	c/a.
0·64	1·025	1·18	1·048
0·76	1·033	1·37	1·055
0·91	1·035	1·44	1·058
1·03	1·043		

The X-ray study has shown that the tetragonal structure in all specimens exists not only on the surface but also within at a depth of 5 mm. Table I.

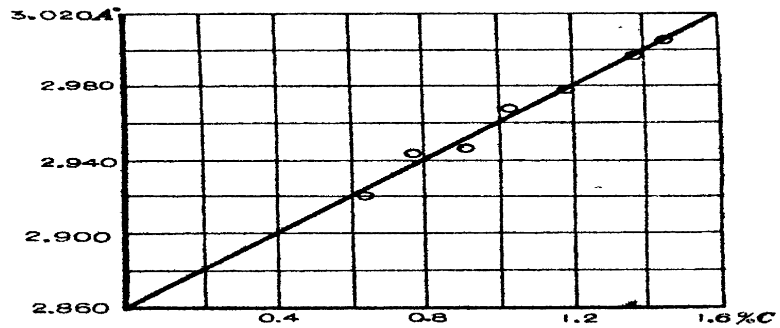

FIG. 1.

represents the middle datum or the ratio of the axes and the carbon content in the specimens of steel quenched in water at 1000°. The greatest deviation from the middle datum of the ratio of the axes was 0·003–0·004. It was found that the length of the c axis is increasing whilst the length of the second

[1] W. Fink and E. Campbell, *Trans. Amer. Soc. Steel Treating*, May 1926. N. Seljakow, G. Kurdumoff, and N. Goodzow, *Zeit. f. Phys.*, 45, 384; 1927.

[2] K. Honda, *Archiv. d. Eisenhüttenwesen*, Heft 8, Feb. 1928.

axis a is diminishing with the increasing carbon content (see Figs. 1 and 2).

The investigation of the influence of the initial temperature has shown that the steel with 1·03 per cent of carbon has a constant ratio of c/a axes at the temperatures 900°, 1100°, and 1300° (1·041–1·045). In the specimens of steel with 0·91 per cent of carbon the diminishing of the ratio of the axes begins at 850°. The lines of the tetragonal structure are more diffuse with temperatures of quenching from 900° and below than with the higher ones.

Simultaneously, in the different layers of the specimen is to be seen the great deviation of the ratio of the axes. The inhomogeneity of the tetragonal structure causes the diffusibility of the lines of the X-ray photograms. The presence of austenite was revealed in all specimens. In the specimen with 0·64 per cent of carbon it was found only within, where in every case the quantity of the austenite prevailed. The steel with 0·91 and 1·44 per cent of carbon when quenched in oil gives more austenite than when quenched in water.

In the case of the great heterogeneity of the small ratio of the axes, each pair of lines in the tetragonal structure may give one very diffuse line. Such a photogram shows the same appearance as that representing the cubical structure. It is very probable that the Honda's β-martensite, in which Sekito [3] investigated the change of the parameter by the removal of the line (110), is a mixture of the tetragonal crystals with different small ratios of the axes. A similar case was published by N. Seljakow, G. Kurdumoff, and N. Goodzow; these workers found in the photograms of the quenched steel a displacement of the line (110) corresponding to the line (110) of α-iron. At first they considered this as an example of cubical structure. On closer examination it was found that the lines were displaced on the photograms in different directions compared with the positions of the lines on the α-iron photograms, which was ascribed to the displacement of the more intense lines of the tetragonal lattice of the martensite.

Sekito has found in the quenched steel with 1 per cent of carbon the relative increase of the parameter $\Delta a/a = 0{\cdot}0045$, where a is the length of the cube edge of α-iron. Using Tamaro's data for the density of iron and quenched steel, Sekito calculates $\Delta a/a$ from the equation $\Delta a/a = -\frac{1}{3}\Delta\rho/\rho$, where $\Delta\rho$ is the difference between the density of α-iron and that of

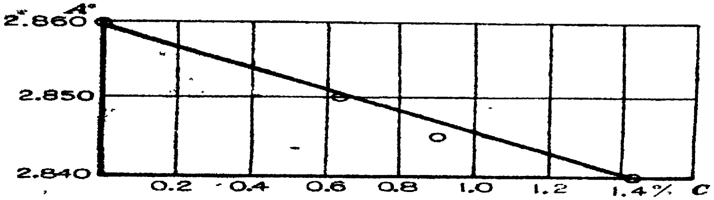

FIG. 2.

the quenched steel, obtaining for the quenched steel with 1 per cent of carbon $-0{\cdot}0044$. Such a calculation, however, takes no account of the presence of the carbon.

The present X-ray study shows that the martensite can be considered as the solid solution of the carbon in α-iron. Hence $\rho = \mu/v$, where ρ is the density, μ the molecular weight, and v the volume of a unit cell.

$$\Delta a/a = -\tfrac{1}{3}\Delta\rho/\rho + \tfrac{1}{3}\Delta\mu/\mu.$$

[3] Sekito, *Z. f. Krystallographie*, 67, 285; 1928.

For the steel with 1 per cent of carbon $\Delta\mu/\mu = 0{\cdot}01$ and $\Delta a/a = 0{\cdot}0077$. Table II. gives the density of the quenched steel using our data and assuming

TABLE II.

Per cent Carbon.	ρ.	a.	c.
0·64	7·816	2·850	2·921
0·76	7·773	2·849	2·943
0·91	7·787	2·847	2·947
1·03	7·749	2·845	2·967
1·18	7·742	2·843	2·979
1·37	7·725	2·841	2·997
1·44	7·713	2·840	3·005

that the carbon atom finds its place in the interstices between the metallic atoms (see Fig. 3).

$$\rho = \frac{111{\cdot}68(1 + p_2/p_1)}{0{\cdot}6062 \times v},$$

where ρ is the density of the martensite, p_1 and p_2 the percentage of carbon and iron, and v the volume

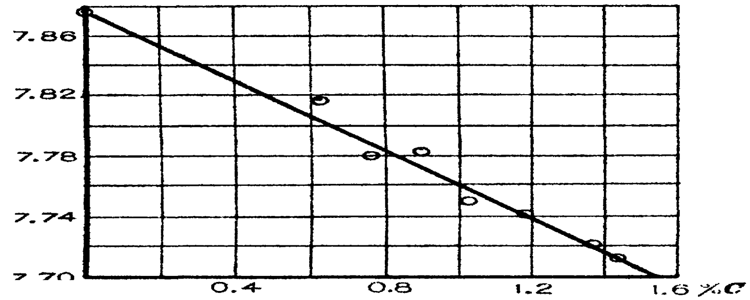

FIG. 3.

of the unit parallelopiped. For α-iron $a = 2{\cdot}860$ A. and $\rho = 7{\cdot}876$. From Sekito's data the density of the steel specimen containing 1 per cent of carbon will be $\rho = 7{\cdot}847$.

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The Dominant Species of *Ostrea*.

DR. ORTON'S letter of Mar. 3 under the above heading, in which he suggests that the genus *Ostrea* might be divided into two genera or sub-genera, *Monœciostrea* and *Diœciostrea*, is very opportune, for it must help to focus attention on one of the most difficult genera in the animal kingdom, regarded from a morphological aspect. But, as Dr. Orton states, more accurate information must be awaited before such a generic grouping can be accepted.

The specific determination of the members of the genus *Ostrea* is in a most unsatisfactory state. In the past, reliance has been placed on shell characters, but these are so extraordinarily variable that, with the exception of a few species, such as *O. nigromarginata* of the Australian Great Barrier Reef, which is cup-shaped and therefore very distinct from the dominant type, it is impossible to embrace the infinite range in a description of any one species. We must endeavour to discover, therefore, anatomical and/or physiological characteristics which will differentiate the species with complete certainty. Take, for example,

the commercial oyster of the eastern Australian coast. This has long been known as *O. cucullata*, a species which was originally described from Ascension Island in the southern Atlantic. It is possible that there are some of these Australian oysters the shells of which simulate the Ascension Island oysters, and may even fit the description of the type specimen, but this cannot be accepted as proof that they are the same species. Probably they are not. The oyster of the southern Australian and Tasmanian coasts, which has been known as *O. angasi*, is stated by Iredale (*Proc. Linn. Soc. N.S.W.*, vol. 49, p. 191; 1926) to be referable to

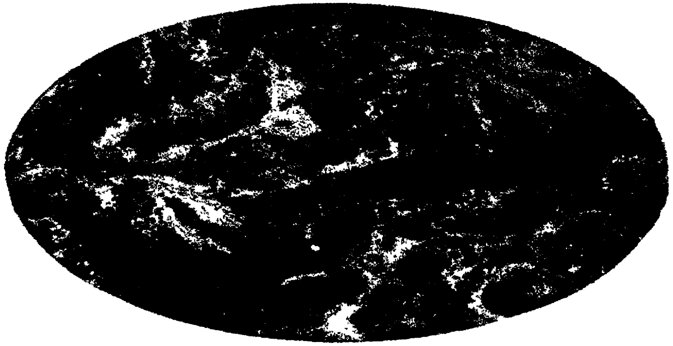

FIG. 1.—Ova and sperms in the gonad of *Ostrea cucullata*, Born. × about 350.

Lamarck's *sinuata*. I do not think it is an exaggeration to say that the specific names of the genus *Ostrea* are in a chaotic state.

The genus can readily be divided into two subgenera, at least in the case of the dominant species, according to whether the adult is larviparous or non-larviparous, but much further research is necessary before classification can be based on monœcious or diœcious characters. Larviparous oysters such as *O. edulis*, *O. lurida*, and *O. angasi* have long been known to be monœcious, and non-larviparous oysters such as *O. virginica* (*elongata*), *O. angulata*, and *O. cucullata* have been accepted as diœcious. But are they? Recent research which I have carried out on the life history of *O. cucullata* has shown that, although it spawns direct into the water, where fertilisation and the whole of embryonic and larval development takes place, it is nevertheless monœcious. On every occasion when I have examined microscopically the gonad of *O. cucullata*, I have found females to predominate, and early last year I had a hundred oysters sent to me from each of thirty different localities on the New South Wales coast in order that I might work out accurate percentages of females to males. In every instance I found that the females outnumbered the males, the percentage ranging from 54 per cent to 88 per cent, the average being 73 per cent. Toward the end of this investigation I opened fifteen very young oysters which were attached to some larger ones, and found that macroscopically the gonad was just showing signs of development. Every one contained actively motile sperms but no ova. Larger numbers of very young oysters were then obtained, and all, with the exception of possibly 5 per cent, contained sperms only. From this it would appear that *O. cucullata*, like *O. edulis*, spawns first as a male and undergoes a series of sex changes afterwards, the small percentage of young oysters examined which contained ova having possibly already spawned as males.

Having concluded that a sex-change occurs, an effort was made to discover specimens which were actually changing over, or, in other words, which contained both ova and sperms. When examining ova under the microscope by ordinary transmitted light, one is apt to overlook any sperms which may be in the field, and perhaps to confuse them with the Brownian movement of particles of protoplasm. In order that the search for sperms amongst ova might be as critical as possible, the sex products of every oyster were first examined by transmitted light and then by dark-ground illumination. The former clearly demonstrates the ova; the latter throws up the sperms in unmistakable relief. As a result of this combined examination, nine oysters were found the reproductive organs of which contained both ova and sperms. Sections of the whole of these were cut, and a photomicrograph of one of them accompanies this letter (Fig. 1).

An important field for research into the sex-change of our non-larviparous *O. cucullata* now presents itself, and this I intend to explore as opportunity permits.

Kellogg (*Bull. U.S. Fish Comm.*, vol. 10; 1890) has described and figured the occurrence of both ova and sperms in a specimen of the American Atlantic coast oyster, *O. virginica* (*elongata*), and Amemiya (NATURE, vol. 116, p. 608; 1925) has recorded two in the Portuguese oyster, *O. angulata*. Is it possible that these oysters also undergo a regular sex-change?

T. C. ROUGHLEY
(Economic Zoologist).

Technological Museum,
Sydney, N.S.W., July 25.

The Raman Effect in Crystals.

THE thermal agitation of the atoms in solids results, as was shown by Raman (NATURE, Jan. 12, 1922, and Jan. 6, 1923), in a noticeable blue opalescence in the interior of such transparent crystals as quartz or ice when they are traversed by a strong beam of sunlight. In his address on the discovery of a new type of secondary radiation (*Indian Journal of Physics*, Mar. 31, 1928) Raman described observations showing that

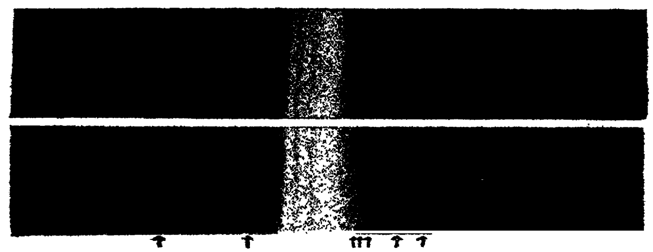

Fig. 1.

Fig. 2.

monochromatic light scattered in this manner by crystals is accompanied by radiations of altered wavelength in the same way as in the case of gases and liquids. The difference between the incident and scattered frequencies corresponds, of course, to a characteristic infra-red frequency of the crystal.

Some of the frequencies revealed in this way correspond to infra-red radiations of much greater wavelength than those known previously from the work of Rubens and others on the *rest-strahlen* from crystals. Fig. 1 represents the incident radiation

(the 4358 A. group of the mercury arc), and Fig. 2 the spectrum of the light scattered in quartz, where the positions of the new lines are marked by arrow heads.

The wave-lengths of the longest radiations from quartz determined from these and other photographs are 118μ, 94μ, 78μ, 48·5μ, 37·4μ, and 21·5μ. Some of these have been overlooked by Landsberg and Mandelstam (*Comptes rendus*, July 9, 1928) and by I. R. Rao (*Ind. Jour. Phys.*, vol. 3, part I., August 1928), who have recently studied the Raman effect in quartz, apparently owing to the insufficient resolving power of their instruments.

K. S. KRISHNAN.

210 Bowbazar Street,
Calcutta, Aug. 16.

Recent Developments on Jupiter.

A GREAT revival of activity in the equatorial and south tropical regions of Jupiter has recently set in, and the developments are so rapid and the phenomena presented so interesting that it seems desirable to direct the attention of telescopic observers to what is in progress. The revival began by the appearance of a dark spot in the latitude of the south edge of the south equatorial belt and in longitude 127° (system II). It was observed in the early morning of Aug. 13 by Mr. B. M. Peek, and it quickly began to show marked activity. The extension in the *preceding* direction (which has recently become much accelerated) has reached at the time of writing as far as longitude 20°, and the disturbance in this part is composed of a series of bright spots and dark peaks and areas. They are mainly in the latitude normally occupied by the south equatorial belt. On the *following* side of the origin of disturbance a number of small dark spots, which appear to have been successively ejected, are travelling along the south component of the south equatorial belt, rather like beads on a string, in the direction of increasing longitude at the enormous rate of about 5° per day! This corresponds to a rotation period of about 9^{h} 59^{m}, which would seem to be unprecedented so far as our knowledge of the planet goes.

These remarkable objects are rapidly approaching the Great Red Spot, the *preceding* end of which is now in longitude 303° ± and in nearly the same latitude. One of them—if it still exists—must have already reached the Red Spot, but unfortunately it faded just before conjunction. It is important to find out what exactly happens at such times, and it is hoped that observers will keep a careful watch on the planet at this exceptionally interesting juncture. It is fortunate that the prolonged spell of fine weather has made it possible to piece together a fairly complete record to date of the remarkable developments now in progress.

THEODORE E. R. PHILLIPS.

Headley Rectory,
Epsom, Sept. 18.

Correlation.

IN NATURE of Aug. 4, p. 171, Mr. Gheury de Bray comments upon a graphic method which I described. In his glance at my letter Mr. de Bray appears to have missed the first sentence, which states that the method is "For the determination of a linear function of X approximating to Y for a range of corresponding values (X, Y)."

In my example, 1·00 is the mean deviation of Y from the function (40 − 3X)/5. From the function 9·25 − 0·75X, which Mr. de Bray's glance shows to be a far better solution, the mean deviation is 1·17.

A. F. DUFTON.

Greenbank, Garston, Herts, Aug. 8.

IS the mean deviation of any use at all for the present purpose? In many cases this criterion does not discriminate between an infinity of graphs, each of which will suit equally well (by this criterion, that is) the given points? Take, for example, the four points at the corners of a rectangle. The graph may coincide with the two long sides, with *any* line parallel to these and situated between them, with the two diagonals, or with *any* line passing through the centre and cutting the short sides! In each case the mean deviation from the function will be the same! Is that a criterion at all?

A practical physicist will take the graph which passes most evenly among the points. His criterion is therefore a double one: (1) the points will 'pair off,' the points of each pair being on either side of the graph at apparently the same distance from it; (2) the maximum deviation shall be as small as possible. The first criterion gives a mean deviation zero, *taking the signs into account*. This would only give for the graph a choice of positions coinciding with *any* line through the centre cutting the small sides. The lines parallel to the long sides are eliminated, except one. The second criterion eliminates all the other lines except the longitudinal axis, which is the best graph.

M. E. J. GHEURY DE BRAY.

40 Westmount Road,
Eltham, S.E.9.

Designation of the C.G.S. Unit of Acceleration.

DR. NORMAN CAMPBELL, in his recent book, "Measurement and Calculation," laments the absence of a name for the C.G.S. unit of acceleration, and the phrase "centimetres per second per second" is certainly clumsy. I am not aware if any names have hitherto been proposed, but I venture to put forward tentatively the claim of 'gal,' for Galileo. It has the merit of brevity, and also of recalling, like the names of the electrical units, the work of a great pioneer in the experimental investigation of the subject.

E. S. KEEPING.

University College of Swansea,
Singleton Park,
Swansea, Aug. 10.

Wing Dimorphism in Weevils.

IN a reference which appeared in NATURE of July 28, p. 144, to my paper on the inheritance of long and short wings in the weevil, *Sitona hispidula* (*Trans. Roy. Soc. Edin.*, vol. 55, part 3, No. 27), a statement occurs which it is desirable to correct. It is stated in the note that evidence from breeding indicates that the abnormal condition of the wing muscles in long-winged weevils is inherited, probably as a Mendelian recessive. The latter part of this sentence is inaccurate, for it was the character normally developed wing muscles which I suggested might be inherited as a Mendelian recessive.

DOROTHY J. JACKSON.

North Cliff,
St. Andrews,
Fife, Sept. 13.

Selective Association in Kittens.

MY cat has four kittens; two of them are black and white, and two are black. They are only three weeks old now, but from the beginning they have always been in two pairs according to their colour. Is there any reasonable explanation for this?

RUSSELL.

Ancient Geography in Modern Education.[1]

By Prof. JOHN L. MYRES, O.B.E.

IT is the claim for geography that it co-ordinates regionally the results and conclusions of other sciences in respect to the natural phenomena of each and every region, and that, including, as it must, man's activities among the factors with which it is concerned, it stands in a peculiarly intimate relation with history, that brings it under the special notice of the art and applied science of education, but at the same time has made it so difficult in practice to assign to geographers their proper place and function in educational schemes. It is clearly urgent that those who have views as to what geographical training the 'new stage in education' shall offer should express them without delay.

THE PLACE OF GEOGRAPHY AMONG ASPECTS OF LEARNING.

Geography, as its name indicates, is the systematic description of this earth of ours. But description is not an end in itself. The end, to which it is the means, is a science of the earth, an understanding and interpretation of its meaning. The geographer ascertains, records, compares, and interprets distributions, the arrangement of things on or in relation to the surface of the earth. Geography, that is to say, asks two questions in respect of each geographical fact: *Where* is it observed? And *why just there?*

Obviously, in this general sense, geography is the coequal sister-science of history, which studies and interprets the relations of events in time. But whereas the geographer's observations are for the most part verifiable at will—for he can go back to a place and see it again—the historian is always to this extent behind the times, that he can never catch up historical events at all, still less can he have them repeated. History is always looking for something that is no longer there; geography has the earth ever present, in all its 'young significance.'

Every relation between objects in space is, however, bound up with a relation between events in time. Consequently every geographical fact has its historical aspect, and every historical fact its geographical aspect. What we group together as the 'historical' sciences are inevitably also 'distributional' sciences, because all the facts and events which they study happen *somewhere* as well as *somewhen*.

All human history, then, is regional history, and loses value and meaning when its geographical aspect is overlooked. All geography, on the other hand, and (most obviously) all human geography, depends for its significance on the consideration that it is contemplating, not facts only, but events with causes and effects; processes, of which our map-distributions are momentary cross-sections.

Other aspects of science, the physical sciences, are concerned neither with relations in space nor with relations in time, but ultimately and sometimes quite obviously with quantities and qualities. In respect to all those expressions of *how* things happen, or *how* they are composed, the historical and distributional sciences stand in the relation of applied sciences to the 'pure sciences' of physics, chemistry, and physiology: accepting and employing their conceptions and interpretations, like their vocabulary and notation.

Similarly, those aspects of science which are concerned with the estimation and interpretation of values—with relations, that is, as irreducible to quantitative expression as they are to conjunctions of region or period—have nevertheless ultimately this point of contact with geographical and historical science, that all the values with which they are concerned are values-to-man, and consequently are, as phenomena, characteristic of—perhaps even peculiar to—terrestrial life, and to a relatively recent phase of it.

Now of these three main groups of studies, the human sciences and the natural sciences, in the stricter sense, are alike systematic and consequently collateral studies, only touching each other at their margins. The remaining group, on the other hand, both in its historical and in its distributional aspect, derives its content and its data from any or all of the systematic sciences. There is a historical aspect of botanical study, for example, the palæobotany of fossil plants, linked with the field botany and plant physiology of to-day by survivals of archaic forms of plant life; and there is a geographical aspect, the study of plant distributions, with its intimate bearing on questions of descent and affinity, and its corollary, ecology, which I take to be the special study of co-distributions. Similarly, there is a historical aspect of ethics, and æsthetics, and no less a geographical aspect, brought latterly to some notoriety by current controversies about the 'diffusion' of ideas, as well as of techniques, the latter being but the expression of ideas in the solid, in artefact instead of behaviour.

Throughout these distributional aspects and treatments of the data of systematic sciences, both historical and regional considerations are ever present, ubiquitous, inextricable from each other. At most we may recognise by an obvious paradox that the geographer is concerned with distributions which are relatively stable in point of time—land forms, vegetation types, lines of communication—and the historian with sequences which are relatively stable regionally—the doings of this or that body of people more or less permanently sedentary within a particular complex of geographical conditions. But it follows from this that in the same way as the geographer fails of his duty if he overlooks the fact that, from mountains and the tides to town-planning and aviation, he is in fact dealing with distributions which are changing, though their rates of change vary almost infinitely, so the historian fails to appreciate the significance of historical events if he ignores those historically

[1] From the [illegible]tial address to Section E (Geography) of the Bri[illegible] delivered at Glasgow on Sept. 6.

permanent limitations within which all human revolutions occur, and to which the most stable human institutions owe nearly all their stability.

HISTORICAL AND GEOGRAPHICAL INSTANCES.

We boast, and rightly, that we try to make education practical and useful; that it is a means to an end; and that its end is the establishment of successors to ourselves at least as intelligent, efficient, responsible—*free*, in the old Greek sense of freedom (*eleutheria*) as 'grown-up-ness'—as we are ourselves; and, as we severally hope, a great deal more intelligent, efficient, responsible, and free than most of our own fellow-citizens.

In the first place, then, we train the citizen-to-be in citizenship, which I take to be the modern technical term for what a Roman called *civilitas*. As, however, custom is of necessity both regional and temporal, it is to historical and geographical considerations that we recur when we are challenged to explain our own code, or to excuse those inconsistencies in it which are naturally more obvious to novices and newcomers from the 'next generation' than to old-stagers and 'men of the world' like ourselves. For these purposes we have recourse to records and traditions, reinforcing or mitigating precept by historical illustration; appealing from abstract to concrete, from morality to hero-worship.

Secondly, we have to present analytically the principal factors in the processes which make up the pageant of external Nature and the methods by which they are detected, measured, controlled, and applied to human ends. Here questions of distribution cannot arise. But from the moment when pure science passes over into any kind of practical application, considerations of place and time reappear; for in wild Nature all processes and all material resources are regional; and it is fundamental in human interference with the order of Nature that it displaces things and disarranges that order. At every stage, and more insistently and obviously in each higher stage, we are called upon to 'think geographically'; and most of all when we come to the consideration of man's dealings with his finest tool and worst obstacle, his fellow-man.

Thirdly, then, it is our business to train inborn faculties of observation and inference to make their own analysis of actual regional circumstances, of the given portion of the earth's surface to which the citizen-to-be has access now; and maybe he will never have the chance to deal with any other. Modern geography accordingly adopts increasingly, and almost inevitably, this regional method of study and exposition as being at the same time the most efficient and the most economical in point of time.

ANCIENT GEOGRAPHY OF THE HOMELAND.

Yet even at that elementary stage in which the common aim of all concurrent 'courses' of instruction is to make the child familiar with the leading features of the 'homeland,' historical retrospect comes to play a part of ever-increasing importance; if only because in our time those very features are being profoundly modified. Artificial and for the most part urban or suburban conditions are rapidly encroaching on what was recently rural. Yet what we call 'unspoiled countryside' in most parts of this island is itself in great measure artificial. Fortunately, in our timbered hedgerows, at all events, the principal elements of that ancient regime remain accessible to many of us. Characteristic data, that is, are still available for the reconstruction of that 'unspoiled countryside' for each principal period of national history, without which familiar episodes lose much of their historic value, because they are bereft of their geographical setting.

It would, however, be a very imperfect preparation for citizenship which included the history of British people only. Great as our national literature is, it owes much of its greatness and originality to the fact that it has been so apt to learn; that it has taken into its own texture so much of the best from other great literatures, from Israel, from Greece and Rome. If we would see life truly we must needs see it whole.

ANCIENT GEOGRAPHY IN CLASSICAL STUDIES.

Now it happens that these two cultures, each with its characteristic ideal of what man's life may come to be, represent supreme achievements of humanity within natural regions and regimes strongly contrasted both with each other and with those of the British homeland. Greek life and all its legacy to us are man's solution of the problem not merely of maintaining life under Mediterranean conditions, but also of realising to the full what life under those conditions might become. Conversely, as our knowledge of the later symptoms of decline and disorganisation grows, as we see it pictured in Rostovtseff's "Social and Economic History of the Roman Empire," the fact of a general hardening of the physical conditions—for which there appears to be sufficient evidence, and full corroboration from the course of events in North-Western Europe—goes far to explain the perplexing way in which well-considered remedies failed of their effect, and sometimes even aggravated that 'distress of nations with perplexity' which was imminent already in the last century of the Roman Republic.

This environment, however, happens to be one which illustrates with exceptional facility that interaction of geographical factors which makes all natural regions what they are. Partly no doubt for that reason, but mainly on account of the special interest and importance of its human geography, the Mediterranean region has been long and carefully studied; and is, I think, recognised by many teachers of geography as one of the most valuable for analytical study. There is therefore good reason to urge that at whatever stage the history of the 'classical' civilisation is included in the programme of education, the regional geography of the Mediterranean basin should be its customary counterpart, and that the two courses should be carried on with habitual cross-reference to each other. Conversely, when the proper moment comes for the study of the Mediterranean basin geographically, the history course should be planned so as to supplement it in respect of the more significant achievements of Mediterranean peoples.

Ancient Geography in Simple Bible Teaching.

For the earlier periods of history, and for that other great factor of our own civilisation which is our inheritance from the Ancient East, the difficulties of correlation, which at first sight might appear greater, are in fact insignificant. For here we have ready to hand a great text-book already in compulsory use; at the same time great literature and great history; a great classic of Oriental life and its surroundings, and a masterpiece of English prose; the historical books of the Hebrew people, in our own Authorised Version. With this example before us of what is not only practicable but also prescribed irresistibly by public opinion as a fundamental element in public education, can anyone fairly say either that ancient geography is without direct utilitarian value in modern life, or that there is no room for it in the curriculum?

We all know very well that the Old Testament is sometimes taught more as if it were a collection of parables or allegories than as geography, or history, or even literature; but I venture to suggest that it is in proportion as we teach it as geography, as well as history and literature, that its value as parable or allegory will be most surely appreciated, and its contents will take their proper place, not as legends of an unearthly wonderland, but as contemporary record of a peculiar people, confronted, in a region no less remarkable, with the most momentous crisis that can befall any people, at a crucial period in the growth of the civilisation which is our own.

In Hebrew literature we have what is almost wholly missing in the Greek instance, an autobiography of an immigrant people during the whole momentous process of acclimatisation to regional conditions strongly contrasted with those out of which the newcomers came. Confronted with such novelties and such temptations to 'enter in and possess,' how were such people to behave?

That is one aspect of Hebrew history and geography, its domestic aspect, as an internal reconciliation of folk with place. The other aspect is external: the reaction of acclimatised Israel to the forces which were shaping the world-history of its times. From no single point of view is it more illuminating to survey and take stock of the great civilisations of the Nearer East than from the miniature States which centred in Jerusalem and Samaria; and the fateful separation of these from each other is itself an early symptom of the distractions which those giant neighbours caused.

Here, too, as in the Mediterranean lands, there is the less need to give illustrations in detail, since the last twenty years have completely remodelled our equipment for handling these regions and periods in every degree of elementary and more advanced treatment. It is no longer honest to plead ignorance of German as an excuse for shirking a public duty. Further, since our own country has incurred the obligations of its mandates for Babylonia and Palestine, in addition to its responsibility for the security and well-being of Egypt, we cannot plead that the geography of these regions lies outside the scope of political duty, or the daily needs of every one of us. We may not want to understand those countries or their peoples; but as things stand we neglect those studies at our peril: and, at least, let us provide for our children.

Present Discontents.

I am well aware that the correlation which I have proposed will be regarded as something of a revolution in the teaching of 'classical subjects,' and also that there are historical reasons for the methods actually employed. To judge from experience both of examinations in history and in geography, and of informal conference with teachers and taught, what passes for 'historical geography' is still one of the weaker aspects of the geographical course, while what has been described as 'geographical history' is scarcely attempted at all.

In discussions of elementary training we hear a good deal of the co-ordination of brain, eye, and hand. Why is it that as we ascend our educational ladder this primary necessity seems to be progressively ignored in the study of the humanities? With every allowance for the disciplinary value of games, such lack of manual dexterity as I have described is a serious defect of scholarly equipment. It is only not realised as such, because the chief employers of the 'finished' output of the humanistic courses in our universities are still themselves so inexperienced in graphic methods that many of them would have some difficulty in understanding a fully illustrated report on any regional topic.

In every other aspect of learning and advanced study, competent use of its special symbols and notation is an elementary prerequisite. But it is amazing how ill-equipped are most students of literary or historical subjects when it is a question of describing anything otherwise than in grammatical long-hand. It is not merely that they are poor draughtsmen; it is rather that they do not do their thinking about regional matters in such fashion that geographical symbols can express it. Yet, considered merely as a test of those qualities of co-ordinated craftsmanship, accurate observation, and clear concise statement of relevant facts, map-making ranks high. A finished map is a scientific document, but it is also a work of art; to its scientific value, its completeness and accuracy, it adds the value which is given by style. What is true of a map, the geographical document in its simplest and most purely geographical form, is just as true of other geographical work, which is all a more or less explicit commentary on maps, in literary form, or hints for the comparison of maps with one another.

It is in those compartments of our educational system where ancient history holds the most honoured and responsible place, that indifference to geographical considerations has lasted longest and most generally. So long as a numerous and influential class of public servants and legislators is recruited from those compartments, so long will the geographical aspect of historical study continue to be overlooked, merely because the responsibl people have had little or no personal experience of it.

The Centre of the Galaxy.[1]

By Dr. HARLOW SHAPLEY, Harvard College Observatory, Cambridge, Mass., U.S.A.

INTRODUCTION.

FROM current work on the distribution of stars, clusters, and extra-galactic nebulæ, I estimate that at least 90 per cent of the sky is free of obscuring nebulous clouds. It therefore seems like an unhappy caprice in the arrangement of the material world that the centre of the Galaxy is behind impenetrable cosmic clouds, and thus hopelessly concealed from the vision of the only creatures in the whole Galaxy (so far as we know) who are curious about the centre. One investigation after another indicates an obscured region in the southern Milky Way, where the constellations Scorpio, Ophiuchus, and Sagittarius corner together, as the direction to the gravitational and rotational centre of the galactic stellar system. The hundred square degrees immediately surrounding this central point appear to be more than half covered by dark nebulosity; all along the southern Milky Way, within thirty degrees of the centre, the obscuration is heavy; but it is so irregular, fortunately, and so incomplete, that numerous exceedingly faint and distant stars are found in the clear areas. High stellar concentration, behind the obscuring veil that overlies most of the centre, is suggested by the distribution of stars in these transparent regions. Is there a massive galactic nucleus concealed by the dark nebulosity? Or is there an ordinary stellar density comparable with that of the sun's neighbourhood? Is our Galaxy an enormous spiral nebula? Or is it an assemblage of stars and star clouds?

For two or three centuries the philosophical astronomers, recognising that the sun is merely a little brother to many millions of stars, have speculated on the problem of the centre of the universe, or the centre of the Milky Way system. A natural vanity and egocentrism led most speculators to assume that the solar system is central (an assumption that is not yet extinct), but Wright, Kant, Lambert, and others suggested in turn that various conspicuous celestial objects had as good claim to the central place—objects such as Sirius and the Orion Nebula. The measuring of the motions of stars, suggesting rotation about some central mass or masses, has led within the past century to the intimation that the Pleiades or the Perseus clusters might be the controlling central bodies. The more recent extensive star counts have induced various investigators to locate the galactic centre in all quadrants of the Milky Way. Only very recently has astronomical unanimity been approached in placing the direction to the galactic centre in the southern Milky Way, though this was clearly indicated by the analysis of the distances and distribution of star clusters a dozen years ago.

Meanwhile, we have learned of a secondary centre—that of the local system—in the direction of Carina, ninety degrees from the galactic centre; and we have noted, in a preliminary fashion, various other concentrations in special regions of the Milky Way, such as the great star clouds in Cygnus. It is the existence of these localised systems that have led in the past to the variety of results based on undiscriminating counts of stars.

My present discussion of the galactic problem touches on three subjects: the new determination of the direction to the centre, with indications of its distance; the initiation of studies of the variable stars, novæ, nebulæ, clusters, and star clouds in the central region; and a consideration of the probable effect in certain problems of cosmogony of obscuring nebulous clouds.

THE DIRECTION TO THE CENTRE.

My earlier study of the distribution of globular clusters in galactic latitude and longitude was based on less than seventy objects—all the globular systems then certainly recognised. They gave as the direction to the galactic centre the right ascension $17^{h}\cdot5$, declination $-30°$; or, in galactic coordinates, longitude 325°, latitude 0°. This concentration of the globular clusters in the Sagittarius region was of high cosmic significance, however, only because the measures of the distances gave a clear indication that the clusters are certainly a part of the Galaxy and that their space distribution most probably outlines the whole system of thousands of millions of individual galactic stars. The centre of the system of globular clusters could be taken as the centre of the whole Galaxy.

The globular clusters intimated that the sun is some sixty thousand light years from the centre of the system, that it is indeed perhaps half-way out toward the periphery of the greatly flattened discoidal and irregularly assembled stellar system, that the concentration of stars near the sun is merely a local cloud—a sub-system in the Galaxy—and that the scale of measurable space and time is somewhat astonishing when compared with earlier concepts.

Although they are the best tools we have, and are positive and accurate with regard to the direction to the centre, the globular clusters leave something to be desired in the measure of the form and dimensions of the Galaxy. They show a surprising absence from mid-galactic regions—more than appears explainable by nebulous obscuration; they also have peculiarities of their own, and the more distant and difficult clusters do not yet yield precise results. We have, however, been able to increase the number to a little more than one hundred, and to revise the measures of the distances. The plot of the distribution in galactic longitude and latitude is shown in the accompanying diagram (Fig. 1); it indicates that the centre of the globular cluster system lies on the galactic equator (latitude 0°, as before), and that the longitude is $327° \pm 2°$.

The new results, therefore, fully confirm the

[1] Synopsis of the Halley Lecture delivered at Oxford on June 11.

earlier values of the position of the centre. The same value is also indicated qualitatively by the distribution of galactic novæ, planetary nebulæ, and other objects of high luminosity and great distance, and it is shown quantitatively by the distribution of faint galactic stars of all types, as studied by means of selected areas at the Mount Wilson and Groningen Observatories. The results on faint stars, recently published by F. H. Seares, give a value for the direction to the galactic centre differing but three degrees from that above.

It has been a natural inference that a flattened stellar system may be in rotation around its centre of mass, that is, in the case of the Galaxy, around a central nucleus, possibly very massive, in the direction of Sagittarius. Weight is lent to this argument by the analogy with external galactic systems, many of which, like the spiral nebulæ, are obviously of rotational form. Studies of the radial velocities and proper motions of the most remote stars of various types by Oort, Schilt, J. S. Plaskett, and others, show definite evidence of rotation around the same centre as that indicated by globular clusters.

ANALYSIS OF THE CENTRAL REGION.

The distances of the globular clusters are obtained in part by means of their Cepheid variable stars. Recent work on the variables of the long period class shows that they, too, are of use in the photometric methods of estimating distance. Eclipsing stars also have been used with some success in estimating absolute magnitudes and parallaxes. Since all these types of variables are widely scattered throughout the Galaxy, it is clear that a thorough study of their distribution in space can throw light on the structure of the Milky Way. A few years ago we began at Harvard a systematic study of the variable stars in about two hundred fields that thoroughly cover all of the Milky Way within a belt twenty degrees in width. We devote the time of three telescopes and of many workers to this problem. In addition to the hundred thousand plates already available at Harvard for the study of variable stars in Milky Way regions, we have accumulated several thousand especially suited to the study of the faint variables in the richest fields. Six hundred variable stars have been found within the past year, and preliminary data obtained on their types, periods, magnitudes, and distances. To complete the investigation will probably require ten or fifteen years.

For special concentration we have laid out a region around the galactic centre, extending sixty degrees along the galactic circle and forty degrees in galactic latitude. It is estimated that more than seventy-five per cent of the galactic system lies within these bounds, which enclose less than six per cent of the entire sky. The various investigations of the central regions cannot be described here, except to note that they pertain to the distribution of the extra-galactic nebulæ, the diffuse and planetary nebulæ, the galactic and globular clusters, the novæ, and several classes of variable stars.

In the richly populated star clouds that lie within twenty degrees of the central point, several hundred new variable stars have been found, many of which are so faint that they probably lie beyond the centre. Numerous extra-galactic nebulæ, probably far beyond the outermost limits of the galactic system, are seen within fifteen degrees of the

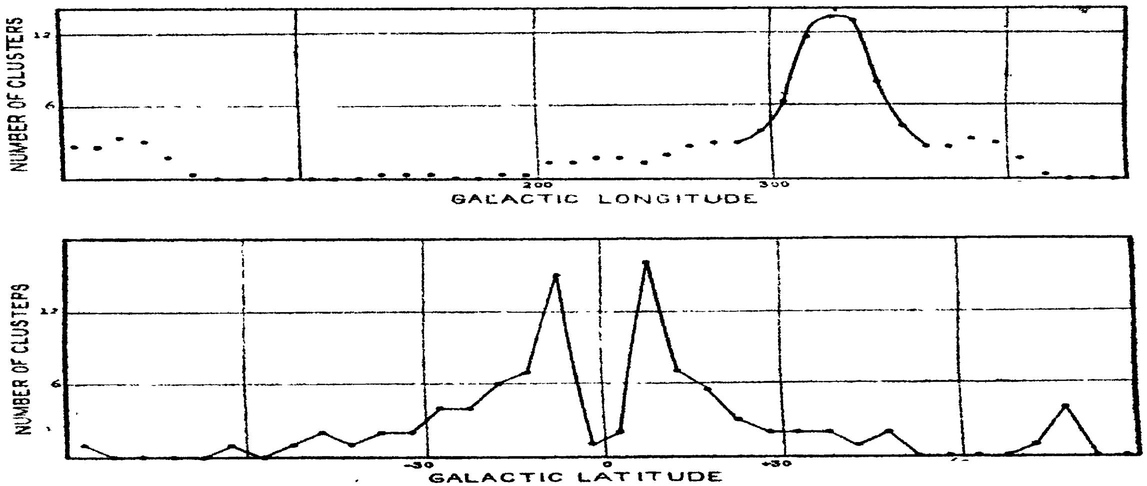

FIG. 1.—Determination of the direction of the centre of the Galaxy.

nebulosity-hidden centre, thus indicating that certain regions near the centre are entirely free of obscuring cosmic clouds. In the Sagittarius region we also have some of the most beautiful bright nebulæ, and the highest density of stars for any region of the Milky Way. It is interesting to note that throughout the central region the open or galactic clusters are closely concentrated to a narrow band which is completely avoided by the globular systems. We take this arrangement to indicate that the galactic clusters are relatively near at hand, most of them, like the bright stars, lying between us and the obscuring nebulosity.

It appears probable that by continuing to feel our way around the edges of the centre-hiding nebulosities, and studying in great detail the stellar distribution in this central region, we shall in time be able to determine the distances of obscuring nebulosities and also to make a better guess at what may lie behind them—a guess as to whether or not our galactic system has a highly massive

nuclear concentration of stars, such as is observed in many of the extra-galactic nebulæ.

DARK NEBULÆ, METEORS, AND STARS.

In studying the distribution and distance of the dark nebulosities in the Milky Way, especially those in the direction of the galactic centre, we are led to investigate the various effects of such nebulosity on the apparent distribution, luminosity, and life of the stars. That such nebulosity is of the nature of meteoric dust is now generally accepted. It effectively blocks the light in many regions, and in some others there is a perceptible localised reddening—for example, for the nebulous stars studied by Seares and Hubble. That moving nebulosity may also incite the variability of stars is strongly suggested by the large number of irregular variables found in such regions as Orion.

In our recent spectroscopic work we have found, however, a more significant effect of meteoric nebulosity. In microphotometer tracings of the spectra of stars in the Pleiades, and of other hot stars, a shallow absorption band appears between Hγ and Hδ, in the region where in cooler stars the well-known cyanogen band occurs. The same tracings show on the violet side of the Ca^{+} lines, H and K, a wide and fairly strong absorption band, and this region is that where the strongest and most easily excited lines of iron and magnesium are found in the cooler stars. These absorption bands, very prevalent in the hotter stars where molecular band absorption is not to be expected as a normal feature of the hot stellar atmospheres, have apparently been overlooked in the past because specially exposed spectrograms and careful spectrum analysis are required to bring them out. Thus the iron and magnesium 'ultimate-line band' is in a region rarely shown in the ordinary stellar spectrogram, but they are frequently well shown on the Harvard objective prism plates when over-exposed for the photographic regions usually studied.

Without going into further details, we briefly state that these bands in the stellar spectra probably arise from the absorption of starlight by infalling meteors or by comets and meteors moving at high velocities when the periastra of their orbits are near the surfaces of the stars. The bands are the first direct evidence we have had of the existence of enormous quantities of secondary bodies around stars. The high velocities, through the Doppler effect, smear out the structural detail in the bands, and extend their limits beyond the limits shown by laboratory spectra, or shown by ordinary atmospheric cyanogen and iron in the spectra of cooler stars.

The cyanogen, iron, and magnesium absorption might have been anticipated from a consideration of the probable meteoric infall in nebulous regions. The sun appears to be in a part of space fairly free from nebulosity, but extrapolating from the earth's daily intake of some twenty or thirty millions of naked-eye shooting stars, it is found that the sun absorbs at least a million million meteors a second, or more than a thousand tons of iron, magnesium, silicon, and oxygen, if the average mass of a meteor is of the order of only one milligram. The elements just named are the main constituents of the iron and stone meteors that meet with the earth. The 'ultimate line' absorption is not recorded for silicon and oxygen, which is natural, for the most easily excitable lines of silicon and oxygen are not in an available part of the spectrum.

Several hundred spectra showing the absorption band have been studied at the Harvard Observatory by Miss Payne and myself. The heaviest absorption is found in the most heavily nebulous regions. It seems likely that a part of the mass lost by a star through radiation is replaced by the meteoric infall. In the case of our sun the repletion of lost mass is scarcely appreciable, unless we have much underestimated (as is likely) the average size of meteors, or their frequency at the sun's surface. But in the case of stars in dark nebulous clouds, or even in lighter nebulosity such as the Pleiades, the radiative degradation of a star's energy may be much retarded, or balanced, or possibly even reversed. We appear to have found, as a by-product of the study of the region of the galactic centre, an indication that the meteoric matter of the dark nebulæ, and of space in general, can be observed spectroscopically as it feeds the stars.

The Bicentenary of Capt. Cook.

AMONG navigators of all ages, Capt. James Cook stands without a rival. Born amidst humble surroundings and apparently destined to occupy but an obscure station, by the force of natural ability and character and the cultivation of his talents, he raised himself to the highest rank among naval explorers, adding immensely to geographical knowledge and planting the British flag on two of its finest possessions. Cook was born at Marton, in the Cleveland district of Yorkshire, on Oct. 27, 1728, two hundred years ago. His father was but an agricultural labourer and farm bailiff, and Cook himself, as a boy of thirteen or fourteen years, was apprenticed to a shopkeeper near Whitby. But as on many another, the sea exercised a fascination which could not be resisted, and his youth and early manhood were spent in trading vessels of the east coast, and in the course of time he rose to be a mate. The North Sea was his high school and university; his study, the cabin of a collier.

The turning point in Cook's career came in 1755, when from a vessel lying in the Thames he volunteered for service in the Navy. War was imminent, the press-gang was abroad—the very press-gang Watt, as a youth of nineteen, alone in London, went in dread of—and Cook, volunteering for the service, exchanged his cabin in the merchantman for the forecastle of a man-of-war. He soon received promotion, however, and at that time there could have been few, if any, who by their industry,

sobriety, disposition, and experience were better fitted for service in the fleet. Four years later, in 1759, he was appointed master or navigating officer of the *Mercury*, was present at the taking of Quebec by Wolfe, and increased his reputation by surveying the St. Lawrence from Quebec to the sea. Appointed master of the *Northumberland*, he employed his leisure studying mathematics and astronomy, and in the next few succeeding years made his name as a scientific observer by his surveys of the coasts of Newfoundland and Labrador and his observations of an eclipse of the sun.

Cook's great chance in life came at the age of forty with his appointment as captain of the *Endeavour* and leader of the expedition to the Pacific to observe the transit of Venus of June 3, 1769. Circumstances had rendered the observations of the transit of 1761 unsatisfactory, and astronomers therefore looked forward with hope to that of 1769. So early as 1766 the council of the Royal Society began to discuss the matter, and in February 1768 a memorial was addressed to George III. submitting "That the passage of the Planet Venus over the disc of the Sun, which will happen on the 3rd of June in the year 1769, is a phenomenon that must, if the same be accurately observed in proper places, contribute greatly to the improvement of Astronomy, on which Navigation so much depends." . . . "That a correct set of observations, made in a Southern latitude, would be of greater importance than many of those made in the Northern," but "That the Royal Society are in no condition to defray this expense." etc. The outcome was that Lieut. Cook and Mr. Green were to be sent to the Pacific, Messrs Dymond and Wales to Hudson's Bay, and Mr. Call to Madras. Cook, granted a lieutenant's commission in May 1768, was placed in command of the *Endeavour* of 370 tons, and on Aug. 26, 1768, left England, Green, Banks, Solander, and other men of science accompanying him.

For the expedition Smeaton had constructed portable observatories, and the Royal Society provided two reflecting telescopes, one with a Dollond micrometer, an astronomical quadrant, an astronomical clock, an alarm clock, a brass Hadley's sextant, a barometer, two thermometers, and a dipping needle. Otaheite, or Tahiti, was reached on April 13, 1769, and the transit was successfully observed on June 3. Sailing westward, Cook then called at numerous islands, circumnavigated New Zealand, hoisted the British flag in New South Wales, skirted the hitherto unknown eastern coast of Australia, and after a stay at Batavia—where, unfortunately, sickness attacked the ship's company—he sailed for home around the Cape of Good Hope and anchored in the Downs on June 12, 1771, thus completing one of the most notable and fruitful voyages on record.

Cook's second voyage lasted from July 13, 1772, until July 30, 1775. Its main object was the circumnavigation of the globe in high southern latitudes, with the object of determining the existence or otherwise of a great southern continent. For this expedition the *Resolution* of 462 tons and the *Adventure* of 336 tons were purchased, and were equipped in the most liberal manner by the Admiralty. Though Cook met with no such Antarctic continent as was supposed to exist, he again circumnavigated New Zealand, exploring the eastern and southern parts; he discovered New Caledonia and Norfolk Island, and made many other additions to geographical knowledge.

This voyage, moreover, was remarkable for the methods by which Cook was able to keep his crew free from scurvy; out of more than a hundred men in the *Resolution*, he lost only one through disease, an achievement that he regarded as his greatest. On his return home he was made a post captain on Feb. 29, 1776, he was elected a fellow of the Royal Society, and later in the year received the Copley medal for his paper containing "the Method he had taken for Preserving the Health of the Crew of H.M.S. The *Resolution*." "If Rome," said Sir John Pringle, "decreed the Civic Crown to him who saved the life of a single citizen, what wreaths are due to that man who, having himself saved many, perpetuates the means by which Britain may now, on the most distant voyages, preserve numbers of her intrepid sons, her mariners; who, braving every danger, have so liberally contributed to the fame, to the opulence, and to the maritime empire of their country."

While Cook was still exploring towards the South Pole, the Royal Society was endeavouring to persuade the Admiralty to ascertain "the probability of navigation being practicable nearer the North Pole than has been generally imagined." In 1746 Parliament had offered £20,000 for the discovery of a passage from the Atlantic to the Pacific to the northward, but little had been accomplished. In 1773, however, Capt. Phipps, with the *Racehorse* and *Carcass*, reached latitude 80° 48′ before being turned back. A year later the scheme was again brought up with the additional proposal of sailing northward in the Pacific. It was this that led to Cook's third and final voyage, begun ere he had been home a year. He was again appointed to the command of the *Resolution*, while Capt. Clerke accompanied him in the *Discovery*. His instructions were to revisit some of the newly discovered islands in the Pacific and then to proceed northward along the western coast of North America. Having in the course of the voyage discovered the Hawaiian or Sandwich Islands, Cook arrived off the coast of America on Mar. 7, 1778, but in August, having reached latitude 70° 41′, the ice presented an impenetrable barrier and he returned to winter in the newly discovered Sandwich Islands. It was then he landed on Owhyhee, or Hawaii, the largest of the group, for the first time, and it was on the shore of Kealakakua Bay in Hawaii he met his death at the hands of the natives on Feb. 14, 1779, being then a little more than fifty years of age. It was the one hundred and fiftieth anniversary of Cook's discovery of the Hawaiian Islands which was celebrated at Honolulu and elsewhere last month, while it is the two hundredth anniversary of the birth which has been celebrated in Yorkshire this month.

Many competent judges have spoken of Cook's

work as an explorer and discoverer. As a circumnavigator, one writer has said that Cook stands unequalled "first for the magnitude of the work done in the time, second for its accuracy, third for the preservation of the health of his people." His efficiency as a commander and his scientific and seamanlike qualities were not alone responsible for his success. "His personality had more to do with it than his efficiency. What manner of man he was is shown by the fact that during the many weary months when the ship's companies were confined together in a small vessel the entries of punishment in the log-books were fewer than could be found in any other ships in the service at that time." It was, however, the French Admiral Dumont d'Urville, himself a distinguished explorer, who said that Cook was the "most illustrious navigator of both the past and present ages, whose name will for ever remain at the head of the list of sailors of all nations."

Obituary.

Prof. E. C. Grey.

EGERTON CHARLES GREY, who died on Aug. 10 at the early age of forty-one years, had long been engaged in researches on the biochemistry of fermentation by bacteria. Working with large inoculations of the organism and synthetic media, he made a careful study of the time relations of the chemical changes and found that well-defined phases of fermentation existed, characterised by different products. Thus, *B. coli*, under these conditions, produces from glucose, in the period immediately following inoculation, alcohol, formic acid, and succinic acid, whereas in the next subsequent period these products are partially decomposed, some of the sugar is synthesised to a non-reducing saccharide and lactic acid is formed; finally, a prolonged period of mixed fermentation occurs.

These experiments, coupled with the observation that the action of the bacteria on sugar varied according as the organisms had been grown aerobically or anaerobically, led Grey to the view (expressed in a paper which has appeared since his death in the *Proceedings of the Royal Society*) that the modified alcoholic fermentation produced by *B. coli* (which he regarded as strictly analogous to the alcoholic fermentation produced by yeast) was only possible when the organism had been recently grown in the presence of free oxygen, zymase (the alcohol-producing enzyme system) being the surviving portion of the respiratory mechanism, and alcoholic fermentation the result of its continued action, under anaerobic conditions.

Grey was the second son of the late Col. Arthur Grey, and, after his schooldays in Paris, graduated in the University of Sydney. After his return to Europe in 1912 with an 1851 Exhibition Scholarship, he became successively Beit Fellow and John Foulerton Student of the Royal Society, working at various times at the Lister Institute, l'Institut Pasteur, and the Biochemical Laboratory, Cambridge, and was awarded the degrees of M.A. (Cantab.) and D.Sc. (London), besides obtaining a medical qualification. During the war he served as a second lieutenant in the Royal Fusiliers, was wounded at Gallipoli and invalided from the service: afterwards he was engaged for a while as surgeon-sub-lieutenant to H.M.S. *Nereide*, and as interpreter in French and German, and took part in the operations in the Black Sea.

After the War, Grey was appointed to the chair of chemistry in the University of Cairo, and was decorated with the Order of the Nile. He relinquished this appointment to undertake research for the League of Nations on the food problems of Japan, in which connexion he made, in six months, analyses of all the typical foodstuffs of the country. He was the author of a book in which he described a new method of teaching analytical chemistry which he had found useful in his Cairo classes.

Grey was a man of attractive but unconventional character, full of enthusiasm for his subject. His early death is a great loss both to his friends and to biochemical science. A. HARDEN.

THERE are many who will regret to learn of the death of Mr. George Newlands, the Advisory Officer in Soils in the North of Scotland College of Agriculture. Mr. Newlands was a graduate of the University of Aberdeen and specialised in geology and in chemistry. After serving for a time as assistant to Dr. Gibb, the professor of geology, he worked as a chemist in munition works during the War. After his war service he joined the staff of the North of Scotland College of Agriculture as a research worker in soils under Prof. Hendrick, with whom he published a number of papers on the mineralogical constitution of the soil. He recently went to visit laboratories on the continent engaged on research work on soils; when there he was taken ill and died rather suddenly in Berlin. Never of very robust health, he had overstrained himself in an attempt to see as much as possible in a limited time. Soil science has lost in Mr. Newlands a worker of great promise who had reached the stage at which his work was becoming fruitful.

WE regret to announce the following deaths:

Mr. George M. Beringer, a past president of the American Pharmaceutical Association, and formerly editor of the *American Journal of Pharmacy*, on June 23, aged sixty-eight years.

Mr. William Brown, lecturer in veterinary hygiene and agricultural bacteriology in the University of Aberdeen since 1913, and joint author of "The Modern Veterinary Adviser," on Sept. 3.

Sir Horace Darwin, K.B.E., F.R.S., founder and chairman of the Cambridge Instrument Co., Ltd., on Sept. 22, aged seventy-seven years.

Mr. W. S. Gray, Director of Chemical Section, Ministry of Agriculture, Cairo, on Aug. 31, aged fifty-four years.

Dr. Robert Knox, president of the Röntgen Society, a distinguished pioneer in medical radiology, on Sept. 21, aged sixty years.

News and Views.

THE scientific testing of materials, which may be said to have grown up from the work of Fairbairn, Hodgkinson, Wöhler, and other pioneers, has during the course of time led to the formation in most countries of societies, the main object of which has been the extension and co-ordination of this important side of scientific and technical work. Up to 1914 there was also an International Association for Testing Materials of Construction, the activities of which, however, ceased with the War and were not resumed. At a congress in Amsterdam in 1927 another society, the New International Association for Testing Materials (N.I.A.T.M.), was inaugurated with a simpler and more satisfactory organisation, and, to ensure adequate British representation on this, a British committee was formed consisting of delegates from the principal engineering, metallurgical, and chemical societies of the country, including the Department of Scientific and Industrial Research. Of this British committee, Sir Henry Fowler is the chairman, Mr. G. C. Lloyd is the honorary secretary and treasurer, while Dr. W. Rosenhain is the delegate to the permanent committee of the N.I.A.T.M. The British committee, 28 Victoria Street, S.W.1, in the interest of the science and art of testing in Great Britain, and in view of the importance of the maintenance of British status, has now issued an appeal to the members of the constituent societies and institutions to become members of the N.I.A.T.M., the subscription being the nominal sum of 10*s*. A Congress is to be held at Zurich in 1931, and others are to be held every three or four years, and members of several years' standing will be entitled to certain privileges. It may also be remarked that the work of the new Association is being divided between four international committees dealing respectively with metals, inorganic non-metallic materials (cement, concrete, etc.), organic materials (oil, indiarubber, etc.), and methods of testing, and of the first of these committees Dr. Rosenhain is the chairman.

THE starting of a company to provide an instrument which will receive pictures from the British Broadcasting Company next month is of interest to all who possess loud speakers. The instrument is called a 'fultograph,' and is interchangeable with an ordinary loud speaker. Simultaneously with the sending from the broadcasting station the picture is reproduced on a sheet of prepared paper which is attached to a revolving cylinder forming part of the apparatus. It is set in action by the release of a lever and begins to work automatically as soon as the transmission commences from the broadcasting station. The reproduction takes place in full view of the observer, who is able to see the building up of the picture, and no development of any kind is required. Upon the completion of the transmission a facsimile of the picture appears on the paper, which is then detached from the apparatus. The B.B.C. has made satisfactory experiments with these 'still' picture transmissions. It has decided to make arrangements for a short transmission daily from Daventry 5XX over a period beginning in October next. The Fultograph system will be used for the October transmission. Any future changes in the system of transmission with the view of the adoption of a standard must naturally be governed by technical developments. The Fultograph Company intends to grant licences to newspaper proprietors and news agencies to transmit photographs and other material over private telephone lines to be installed for such purposes. The apparatus transmits and receives minute details. It can give, for example, exact reproductions of finger prints. Although not so interesting as seeing moving pictures, the apparatus should prove useful for some purposes.

SOME of the chief problems of Antarctic exploration were noted in an article in the *Times* by Sir Edgeworth David in relation to Com. R. E. Byrd's forthcoming aeroplane expedition. Sir Edgeworth points out that the Bay of Whales on the Ross Barrier, where Com. Byrd proposes to make his base, is an excellent site for an attack on the chief problem of the Antarctic, that is, the relations of the Antarctic horst of the Ross Sea with the Antarctic Andes of Graham Land. The exploration of the gap between Carmen Land, on the east of the Barrier, and the Queen Maud Ranges is important. Sir Edgeworth suggests that a second base might be placed in Graham Land. He does not give the locality, and the difficulty would be, as the *Scotia*, *Endurance*, and *Deutschland* have shown, to reach a satisfactory base by sea. Foreseeing the danger of wintering a ship either at the Bay of Whales or in the Weddell Sea, Sir Edgeworth suggests that during the winter the ship might profitably be employed in sounding and dredging in Antarctic seas. No doubt a certain amount of such work might be done in winter, but the darkness and very stormy weather would not allow any extensive programme of work south of lat. 50° S. The suggestion is made that aeroplanes might be most usefully employed in laying down outlying stations in suitable places for intensive geological work and also as a rapid means of securing meteorological data from the higher layers of the atmosphere. It is in the study of Antarctic meteorology that we may look for the most definite practical results. The *Daily Chronicle* of Sept. 24 has an article on the programme of the expedition by Com. Byrd, and will publish dispatches from the expedition from time to time.

THE departure on Sept. 22 of another Antarctic expedition has been announced by the New York correspondent of the *Times*. Sir Hubert Wilkins, accompanied by Lieut. C. B. Eielson and Mr. J. Crossan, pilots, Mr. W. Gaston and Mr. O. Porter, mechanics, has sailed from Montevideo on the first stage of his journey to Deception Island, from which he hopes to make an aerial survey of the Antarctic continent. The expedition is taking two Lockheed-Vega aeroplanes, and proposes to fly from Deception Island to a point on the Antarctic continent, which will be used as a field base for survey work with the view of establishing meteorological stations. Later,

Sir Hubert hopes to fly to the Ross Sea, where Com. Byrd will be at work, and make a base there for further observations.

DR. EDWARD R. WEIDLEIN, the Director of the Mellon Institute of Industrial Research, wrote for the *Pittsburgh Record*, the quarterly magazine of the University of Pittsburgh, an article, which has been reprinted as a pamphlet, entitled "Achievements in Industrial Research." He begins by stating that with regard to a carefully prepared list of fifty-five noted inventions, selected because of their economic value, inquiry revealed that all of these great inventions had been made by applying scientific knowledge through experiment. After emphasing the interdependence of 'pure science' or 'fundamental' research on one hand, and 'applied science' or 'industrial' research on the other, and also their intellectual equality, in order of importance and in dignity, he points out that the co-operation in research typified by the combination of forces between the University of Pittsburgh and the Mellon Institute, "reduces to a minimum the time elapsed from the discovery of a principle in science to mass production."

THIS lag between the completion of the laboratory experiments and the full scale application of their results to industry is of great importance to industry in general. Sir Josiah Stamp, who calls it the 'period of gestation,' in a Watt Memorial Lecture delivered at Greenock, has recently directed attention to its economic significance. The various research associations established in Great Britain are well familiar with it as an industrial phenomenon. Increased co-operation between the pure science research workers, the industrial scientific workers, and the industrialists is undoubtedly one way to reduce this lag. Dr. Weidlein makes a fair point when he says: "The electrical industry, which is based upon the pure science research of Michael Faraday, required nearly a hundred years for its development. Compare with that the development of the radio industry or any of our other modern branches of manufacture during this period of better understanding of co-operation among the pure science research worker, the industrial scientist, and the industrialist." The pamphlet contains some apt and striking illustrations of the revolutions effected in many industries as the direct results of the application of the results of scientific research.

IN October 1927 a meeting was held at Washington of the International Union of Scientific Radio Telegraphy—the U.R.S.T. The first instalment of the papers presented at this meeting has now been published by the general secretariat, the offices of which are at 54, avenue des Arts, Brussels. The U.R.S.T. is divided into four sections; the first three cover measurements and standardisation, wave propagation, and atmospherics. The fourth section includes the work of amateurs. The price of the complete volume is 100 French francs. The papers have been written by well-known specialists from many countries. They are commendably short, but describe important results on wave propagation obtained by observation, experiment, and theory. Amongst the papers in this part are two by Prof. E. V. Appleton. He discusses first the question of whether there is one or more ionised layer in the upper atmosphere, and then the influence of terrestrial magnetism on radio transmission. In an interesting paper by H. B. Maris, a theory of the upper atmosphere is advanced which accounts for the phenomena observed in connexion with meteors. There is an instructive paper by Van der Pol on the effect of retroaction on the received signal strength. Other papers discuss frequency standards, short wave transmission, directional observations on atmospherics, the influence of solar activity, radio transmission, automatic recorders, and radio compass calibration.

THE place-names of mineral localities in central Europe have presented many difficulties in connexion with museum classification of specimens and with topographical indexes. The recently published paper on the subject in the *Mineralogical Magazine* (June, 1928, pp. 441-479) by Prof. F. Slavík (Prague) and Dr. L. J. Spencer is therefore of special importance to geologists, mineralogists, and the curators of museums. Prior to 1918 it was customary to use German names for the mineral localities in central Europe. Now that new States have been created, and others enlarged, the official names of many towns have reverted to the vernacular, and the old German and Hungarian names are being discarded in scientific and general literature. Sometimes these have been direct translations of the local names or have been approximate phonetic reproductions of the same names in German and Magyar. An example of the former is Nová Ves, in Czechoslovakia, which was rendered Neudorf in German. On the other hand, Zirovnica in Jugo-Slavia was termed Scheraunitz on pre-War Austrian maps. It must not be supposed that the Czech, Rumanian, and other place-names are new merely because they are in languages not generally familiar. Many of them were in general use in the Middle Ages, and whilst the use of German place-names dates from the time of Agricola, the Hungarian ones are of much more recent origin. In mixed ethnological districts it still happens that certain places have two officially recognised names. Such alternatives are officially recognised in Czechoslovakia when they represent the mother tongue of at least 20 per cent of the inhabitants. The authors of the paper give lists of the State place-names, together with their German and Hungarian equivalents and the minerals found there. The territory covered by these lists corresponds with the former Austro-Hungarian monarchy and those parts of the republic of Poland which previously belonged to Germany and Russia.

IN order that the public may become better acquainted with outstanding features of the Museum collections, a series of special exhibits is being arranged at frequent intervals in the Natural History Department of the Birmingham Museum. The present exhibit is of 'Flightless Birds.' It includes a fine specimen of the South American rhea, sometimes

called the South American ostrich, with its immensely powerful legs, and the wings now relegated to the purpose of balancers when the bird runs. Near by are specimens of the closely related New Zealand kiwi, in which the wings are invisible and the feathers resemble tufted hairs. In the penguins the wings have been adapted for service as paddles. The grass-green owl-parrot of New Zealand illustrates how a bird that had little occasion to use its wings in a land once almost free from aggressive animals, has lost the power of flight and is threatened with extinction now that man has introduced natural enemies. A life-sized drawing shows the great auk, which became extinct less than a century ago, and there is a coloured cast of the handsome egg. Another model of an egg, having a capacity of no less than two gallons, enables one to visualise *Æpyornis*, a gigantic bird from Madagascar which became extinct only within recent times.

THE Prime Minister, Mr. Stanley Baldwin, will open the new Safety in Mines Research Laboratories, Sheffield, on Thursday, Oct. 11.

THE Norman Lockyer Lecture of the British Science Guild will be given this year by Prof. J. Arthur Thomson, Regius professor of natural history, University of Aberdeen, on "The Culture Value of Natural History." The lecture will be delivered on the afternoon of Wednesday, Nov. 28, in the Goldsmiths' Hall, London, by kind permission of the Goldsmiths' Company.

THE Council of the Royal Sanitary Institute has accepted the invitation of the Sheffield City Council to hold its fortieth Congress and Health Exhibition at Sheffield on July 13–20, 1929. A public meeting to inaugurate the arrangements will be held in the Town Hall, Sheffield, on Friday, Oct. 19, at 3 P.M., under the chairmanship of the Lord Mayor of Sheffield.

THE Council of the Institute of Chemistry has decided to utilise the income from the legacy bequeathed to the Institute by the late Sir Alexander Pedler to provide a scholarship to be known as the Pedler Scholarship. The award will be of the annual value of £300, and will be open to fellows and associates of the Institute. The scholar will work on an investigation selected by the Council as being in the public interest, and this year candidates have had a choice of three problems: the sterols of natural fats, determination of sugars in mixtures with special reference to foods, and determination of casein, albumin, and globulin in milk. The expenses of the research will be met by the Pedler Fund.

THE following distinguished foreign men of science will be guests of the Faraday Society at the discussion being held at Cambridge on Sept. 28 and 29 on "Homogeneous Catalysis": Prof. H. Bäckström, Princeton, U.S.A.; Prof. J. Böeseker, Delft; Dr. E. J. Bigwood, Brussels; Prof. J. N. Brönsted, Copenhagen; Prof. H. Copaux, Paris (president of the Société de Chimie et Physique); Prof. H. Dufraisse, Paris; Prof. H. von Euler, Stockholm; Prof. F. Giordani, Naples; Prof. C. Moureu, Paris; Dr. Henri Moureu, Paris; Prof. M. Polanyi, Berlin; Prof. F. O. Rice, Johns Hopkins University, U.S.A. Prof. J. W. McBain, a vice-president of the Faraday Society, now at Stanford University, California, is also attending the meeting.

TWELVE major topics for discussion at the second International Conference on Bituminous Coal, to be held under the auspices of the Carnegie Institute of Technology, Pittsburgh, Pa., U.S.A., on Nov. 19–24, are tentatively announced by Dr. Thomas S. Baker, president of the Institute, and chairman of the Congress. Although the Conference will be similar in purpose to the first congress held in 1926, its scope has been considerably enlarged and the programme is more international in character. The discussion on fixed nitrogen will no doubt arouse considerable interest. The liquefaction of coal, which was one of the principal subjects of discussion at the first meeting, will again occupy a prominent place in the deliberations. Low temperature distillation will be treated by representatives of at least a half-dozen countries. High temperature distillation, power from coal, coal tars, and oils, complete gasification of coal, origin of coal, coal washing, pulverised coal, catalysts, and the general aspects of the bituminous coal industry are other topics that will be considered. Representatives from England include Lord Melchett, Dr. C. H. Lander, Mr. Harald Nielsen, Col. Lindemann, Dr. R. Lessing, and Mr. Edgar C. Evans; France, Germany, Italy, Austria, Belgium, Denmark, Poland, Russia, Japan, Czecho-Slovakia, Canada, Norway, Spain, Chile, Rumania, Jugo-Slavia, and Bulgaria will also send delegates.

MR. C. A. SILBERRAD, Forest Side, Epping, writes to point out that the statement that the month of Muharram of the Moslem year "corresponds with the month of August" in our Calendar of Customs and Festivals published Sept. 1, is not, strictly speaking, accurate. It should no doubt have been mentioned that the correspondence was approximate only and variable. In all equations of the Christian and Moslem Calendar it must, of course, be remembered that Moslem feasts are variable in our dating, owing to the fact that the Moslem calendar is lunar. All dates therefore work back each year approximately eleven days, with a maximum variation of about 22 days.

AN interesting catalogue (No. 508) of books, engravings, original drawings, maps, etc., relating to South and Central America, with short lists on Cuba, Hayti, Porto Rico, and Falkland Islands, has just been circulated by Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1. Upwards of 900 works are listed. The catalogue should be seen by readers interested in South America. Messrs. Edwards also offer for sale, in catalogue No. 509, a number of books on gardening, horticulture, and botany.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant to the Island Professor of Chemistry, Barbados—C. A. (T.), The Secretary, Board of Educa-

tion, Whitehall, S.W.1. For Scottish candidates, C. A. (T.), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Oct. 1). A Bernhard Baron Research Scholar at the Ferens Institute of Oto-Laryngology of the Middlesex Hospital—The Secretary, Middlesex Hospital, W.1 (Oct. 5). A woman lecturer in education at University College, Southampton—The Registrar, University College, Southampton (Oct. 6). An assistant lecturer in the department of Civil Engineering, Architecture, and Building of the Bradford Technical College—The Principal, Technical College, Bradford (Oct. 6). A head of the department of engineering of the Constantine Technical College—The Director of Education, Education Offices, Middlesbrough (Oct. 8). A secretary of the Institution of Gas Engineers—The President, Institution of Gas Engineers, 28 Grosvenor Gardens, London, S.W. (Oct. 9). A full-time assistant lecturer in engineering at the Cardiff Technical College—The Principal, The Technical College, Cardiff (Oct. 13). A senior assistant lecturer in agricultural chemistry at the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (Oct. 15). A laboratory assistant in the food-canning section of the Low Temperature Research Station, Cambridge—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Oct. 15). A bacteriologist in the Department of Agriculture, Irish Free State, in connexion with the Dairy Produce Act, 1924—The Secretary, Civil Service Commission, 33 St. Stephen's Green, Dublin (Oct. 20). A librarian of the British Medical Association—The Medical Secretary, British Medical Association, Tavistock Square, W.C.1 (Oct. 20). A research chemist in the department of Coal Gas and Fuel Industries of the University of Leeds, primarily for research on carbonisation—The Registrar, The University, Leeds (Oct. 31). A principal of the Municipal College, Portsmouth—The Secretary, Offices for Higher Education, The Municipal College, Portsmouth. A temporary lecturer in elementary science and hygiene at the Warrington Training College, Battersea—The Principal, Warrington Training College, Vicarage Road, Battersea, S.W.11. An instructor in metalwork at the Darlington Technical College—The Chief Education Officer, Education Office, Darlington. A research assistant at the Research Association of British Motor and Allied Manufacturers—The Research Association of British Motor and Allied Manufacturers, 15 Bolton Road, W.4.

Our Astronomical Column.

THE APPROACH OF COMET PONS-WINNECKE TO THE EARTH IN JUNE 1927.—This approach was the closest cometary approach to the earth since that of Lexell's Comet in 1770. That comet had been discovered only a short time when it made its near approach, and observers did not know until later how small its distance had been (1⅓ million miles at minimum). Moreover, it does not appear to have presented a sharp stellar nucleus, as Pons-Winnecke did; the latter feature makes it possible to utilise the observations for a deduction of the solar parallax. A necessary preliminary work is the calculation of an accurate ephemeris at the time of near approach. Dr. R. T. A. Innes deals with this problem in *Astr. Nach.*, No. 5570. He notes that when the comet is near the earth, the perturbations of the two bodies by other planets are practically identical, and do not affect the comet's geocentric position. It suffices, therefore, in a solution by mechanical quadratures, to consider only the attractions of the sun and of the earth-moon system. Dr. Innes made successive approximations until the best accordance with observation was obtained. He gives an ephemeris at intervals of a fifth of a day from June 25·0 until July 2·0. The nearest approach to the earth was at June 26·8 when log Δ was 8·5952, giving a distance of 3·66 million miles.

Mr. Bengt Strömgren gives in the same number of *Astr. Nach.* an ephemeris of the comet at intervals of 1 day from April 28 to June 20, with corrections deduced from observation.

THE TRANSIT OF MERCURY IN NOVEMBER 1927.—M. J. P. Lagrula, in *Jour. des Observateurs* for June, discusses the photographs obtained of the transit at Algiers. He claims that photographs obtained when the planet was on the disc give much more reliable results than the visual observations of the times of contacts. The reverse was found in the transit of Venus in 1882, but the technique of solar photographs has improved since then.

The final result of a long discussion of the measures gives positions of the planet indicating that egress occurred $24^s{\cdot}7$ earlier than the time calculated from the *Nautical Almanac* data. This is in very good agreement with the results from visual measures.

M. Gonnessiat found from visual observations at Algiers 20^s from 3rd contact, 26^s from 4th. M. Deslandres found 25^s from a combination of the Meudon observations; Dr. Innes found 23^s from a combination of observations at a number of observatories. The determination is of value for checking both the motion of the planet's perihelion and the supposed variation in the earth's rate of rotation.

JAHRESBERICHT DER HAMBURGER STERNWARTE IN BERGEDORF, 1928.—This publication contains four plates reproducing photographs taken during the total solar eclipse of June 29, 1927, by the expedition sent from the observatory to Jokkmokk (Lapland). The first was taken with 1 sec. exposure, and a focal length of 20 metres. It shows much beautiful detail in the prominences and inner corona. An interesting set of coronal arches over a prominence can be seen in the south-east quadrant. An exposure of 18 sec. with the same instrument shows much greater extension of the corona but less fine detail. There is also a reproduction of a plate with 1 sec. exposure taken with the reflecting telescope. The last two photographs agree closely with each other and show a curious large hollow in the north-west quadrant extending through 50° of position angle: they also show a prominent pair of nearly parallel coronal rays a little south of the east point. The other plate contains seven spectra of the flash and the inner corona, taken with a prismatic camera, the exposures ranging from 1 sec. to 18 sec. The overlap of the moon beyond the sun was so small that many of the images appear as almost complete rings.

Research Items.

EMBALMING IN TAHITI.—A remarkable document relating to Tahiti forms No. 48 of the *Bulletin of the Bernice P. Bishop Museum* of Honolulu. Owing to the fact that development in Tahiti was rapid as compared with other parts of the Pacific, after its discovery accurate information as to its early native institutions is scanty. The best record of its customs about a hundred years ago is contained in Ellis's "Polynesian Researches," published in 1831. In 1848 the Rev. John Muggridge Orsmund presented to the French Government a manuscript embodying the result of his researches on Tahitian customs, institutions and history, drawn from native sources during a residence of thirty years. The manuscript disappeared, but his granddaughter, Miss Teuira Henry, a distinguished linguist and Tahitian scholar, who died in 1915, was able to reconstruct it from the manuscripts and notes left by her grandfather, as well as supplement and check it from her own knowledge. The result is a most valuable and comprehensive work, too wide indeed in scope for summary. The following information in relation to embalming is of interest. The operation was performed by an adept, who required a high remuneration. The body was placed on a portable altar, about three feet high, over a pit. The expert drew out the viscera through the anus, sucked the brains through the nostrils, and then buried them in a secret spot of the marae. The body was then allowed to drain into the pit through an opening in the altar. It was saturated with oil—sandalwood preferred—and the cavity filled to its natural size with tapa soaked in oil. The limbs were rendered pliant by frequent moving and the skin toughened and detached by massage, the flesh being squeezed out through perforations under the joints and dropped into the pit. A small pillar was placed in the pit to represent the body, and it was filled up. The body was then dried in the sun, after which it was placed in a sitting posture and dressed in a tapa cape with a turban. The hair was, if necessary, fastened on with gum.

QUARTZITE IMPLEMENT FROM DURHAM.—Dr. C. T. Trechman has published in Vol. 65 of the *Geological Magazine* a description, with illustration, of a supposed implement of quartzite from beneath the boulder clay of the Durham coast. It was found in a bed of water-deposited gravel at Limekiln Gill, about four miles north of Hartlepool. It has been seen by Mr. R. A. Smith and Mr. Reid Moir, who concur in thinking it definitely human and say that they would expect to find it in some margin between two principal boulder clays (inter-glacial of East Anglia). The specimen is therefore of some considerable significance as it comes from a bed underlying the Cheviot and Northern drift or Purple Clay, which at this spot is at least 70 ft. thick and consists very largely of typical boulder clay. The specimen looks like a rough attempt at a hand axe of Chellean or St. Acheul type. It is 3½ inches in length, 3 inches wide, and 1¼ inches in thickness, and of yellow translucent, faintly banded quartzite. It is roughly chipped, with part of the smooth crust of a water-worn pebble remaining on one side. All the chips are of one period. The Limekiln Gill gravel, where the supposed implement occurred, is later than the Scandinavian glaciation of the Durham coast and later than the Westerly or Stainmoor boulder clay of Hartlepool, but earlier than the Cheviot and Scottish drift, which forms the main mass of the boulder drift that caps the coastal cliffs.

SWANS IN ANCIENT ENGLAND.—The importance attached to the domestic swan in former days is indicated not only by the elaborate system of swan-marking in vogue, but also by the appointment of accredited Masters of the Swans, a subject discussed by Dr. N. F. Ticehurst in *British Birds* (Sept. 1928). Although there are earlier records of the performance of the swan-master's duties, the first definite appointment recorded appears to be that of Thomas de Russham in 1361. The primary duty lay in caring for the royal birds and in maintaining the crown rights, which incidentally involved the supervision of swan-keeping by all private owners. Dr. Ticehurst discusses these various duties in detail under the headings of the maintenance of the royal prerogative, the preservation of the birds themselves, and the safeguarding of the rights of private owners and the prevention of fraud. A list, compiled from many sources, is appended, giving the names of swan-masters and deputies from Thomas Gervys in 1355, to 1799, when Richard Roberts was keeper of the King's swans on the Thames.

LARVÆ OF BRITISH CRABS.—Miss Lebour has continued her studies on the larvæ of the Plymouth Brachyura, and her latest work (*Proc. Zool. Soc.*, part 2, 1928, pp. 473-560) is a very notable contribution to our knowledge of decapod larvæ, since she is able to show that both zoea and megalopa of the Brachyura have definite systematic characters by which the families, genera, and usually even the species can be recognised. Out of 37 species of Brachyura known from Plymouth, she describes the larvæ of 33, and, as among these are represented most of the families of crabs, her survey of the group is of the utmost importance. Those who are concerned with marine plankton will owe much to her for the means now placed at their disposal by keys and coloured figures for the identification of their material; but perhaps the most valuable result is the proof given that these larvæ can be used to check the systematic arrangement of the adults. It is not possible at present to come to definite conclusions on some of the points of difficulty, since so much depends upon the correctness of the identification of some larvæ described by others. Cano's work, for example, has frequently to be brought into the discussion, but unfortunately it is often impossible to discover what ground he had for his identifications, and in some cases they can be shown to have been wrong. Miss Lebour has introduced some changes in the classification, but the most important point seems to be the evidence of relationship between the Leucosiids and the Pinnotherids. Bourne's work on the Raninidæ shows that the Oxystomata are not a natural group, and it is to be hoped that Miss Lebour's paper will lead to a revision of the Brachyura based to a large extent on larval characters. What is needed now is the identification of the larvæ of more of the exotic crabs.

INDIAN INSECTS.—A recent instalment of the useful "Catalogue of Indian Insects," in course of publication, is Part 15 (1928), by Mr. R. Senior-White (Calcutta: Government of India Central Publication Branch. London: High Commissioner for India) who lists the Cecidomyidæ or Gall Midges of that country. Altogether, 44 genera and 87 species are listed, and the publication of such a catalogue should prove a valuable aid to the study of the Indian forms of this important but neglected family of Diptera. The Catalogue, it may be added, is edited by a standing committee of entomologists appointed in India. Each part can be purchased separately, and is published under the authority of the Government of India.

PURKINJE AND THE DISCOVERY OF CELLS.—In a short article (*Anat. Anz.*, Bd. 64, 1927) and in a detailed memoir with full bibliographical references (*Acta. Soc. Sci. Nat. Moravicæ*, 4, Fasc. 4, 1927) Prof. F. K. Studnička of Brünn deals with the part played by J. E. Purkinje and his school in the discovery of animal cells, and concludes that, without undervaluing the contributions of Schwann, more credit should be given to Purkinje and to his pupil and co-worker Valentin. He points out that the principal investigations leading to the discovery of cells in animal tissues were carried out in two schools in Germany—in that of Purkinje in Breslau, and in that of Johannes Müller in Berlin. To the latter school belonged Schwann, whose first papers appeared in 1838. Purkinje and his pupils, who worked in his house, and in particular Valentin, discovered cells—then termed in Breslau *Körperchen*, *Körnchen*, *Kugeln*—in various epithelia (1835–37), in the notochord and in cartilage (1835), in bone (1834), in nervous tissue (1836; they had been already observed by Ehrenberg in 1833), in the pigment layer of the retina (1837, by Valentin, who saw the nuclei), and in various glands, for example, liver, pancreas, mucous glands (1837). Nuclei were observed by Raschkow of the Breslau School in epithelial cells in 1835 and the nucleolus by Valentin (1837, but Rudolf Wagner had seen the nucleolus in 1835), and the names *Cellula* and *Zelle* were used by these authors. Under the direction of Purkinje, systematic researches on the whole range of animal tissues were carried out. In September 1837, Purkinje delivered a lecture in Prague on the gastric glands and their cells which he had recently discovered, and in the plate (reproduced in Prof. Studnička's memoir) he showed also multipolar ganglion cells with their nuclei. Prof. Studnička's documented contribution is of great interest and importance to all concerned in the history of our knowledge of the cell.

POWER ALCOHOL FROM VEGETABLE PRODUCTS.—Some months ago the Department of Scientific and Industrial Research published a memorandum on the production of power alcohol from grasses, straws, and waste vegetable material (Fuel for Motor Transport, Fourth Memorandum, 1927, 9*d*.). In the August issue of the *Annals of Applied Biology* (Vol. 15, No. 3), A. C. Thaysen and L. D. Galloway give further details of their work on this subject. A method has been worked out by which such materials as maize cobs, etc., are hydrolysed by dilute acids and the resulting liquor fermented to give a mixture of ethyl alcohol and acetone, eminently suitable as a motor fuel. No pressure vessels are required, and yields averaging 20 gallons per ton of dried material are reported. The organism employed is the pentose-fermenting *Bacillus acetoethylicus* (Northrop), and the conditions required for a successful large scale fermentation by this organism are fully described.

ENZYMES OF *ASPERGILLUS ORYZÆ*.—There are at least four large industries in Japan in which this fungus is of first importance—in the manufactures of rice wine, soy sauce, soy cheese, and *shochu*, a distilled alcoholic liquor. In this connexion a recent study of Kokichi Oshima on the protease and amylase of *Aspergillus oryzæ* is of some economic value (*Jour. of Coll. of Agri.*, Hokkaido Imperial University, Sapporo, Japan, vol. 19, part 3). A new method is detailed for quantitative estimation of these two enzymes by which determinations can be made easily, rapidly, and accurately. Amylase or diastase is not considered as one simple enzyme. Amylases of different origins often show different velocities of action, when their starch-liquefying, dextrinising, and saccharifying activities are compared. In the present paper the starch-liquefying reaction is determined by measuring the viscosity change of starch paste with Ostwald's viscosimeter, and the enzymatic activity in these determined from a prepared scale. Starch-saccharifying reaction is tested by reduction of Fehling's solution and by finding enzymatic activity from a scale prepared by using a generalisation of Lintner's unit. A protease which acts near to neutral reaction is estimated by casein liquefaction, the undigested casein being found as a precipitate by using a mixture of nitric acid and magnesium sulphate. Some precautions for elimination of errors in the use of Van Slyke's apparatus for the determination of α-amino nitrogen are also suggested.

CYTOLOGY OF SUGAR-CANE HYBRIDS.—It is well known that the sugar-cane in Java has suffered very badly from 'sereh' and mosaic diseases. G. Bremer (in *Archief voor de Suckerindustrie in Nederlandsch Indie*, part iii. 565; 1928) has published an account of crossing and back-crossing varieties of *Saccharum officinarum* and *S. spontaneum* which resulted in the production of hybrids with high sugar content and immune or very resistant to those diseases. The following cytological details are abstracted from an English summary received from the author. *S. officinarum* has 40 chromosomes (haploid) and *S. spontaneum* 56, while the F_1 of the cross between them had 136. The author concludes that the additional 40 chromosomes originated by the longitudinal splitting of the maternal (*S. officinarum*) chromosomes during fertilisation. The F_2 plants in general resembled those of the F_1 generation. Back-crosses of *S. officinarum* and F_1 plants had 148 chromosomes, indicating that the haploid number of the former had doubled again during fertilisation. It was by crossing these back-crosses again with *S. officinarum* that plants were obtained of high value for cultivation and resistant to both 'sereh' and mosaic. The somatic chromosomes of plants from this crossing varied in number from 106 to 120. A hybrid of *S. officinarum* and a variety of *S. spontaneum* from North Celebes again showed an increase of 40 chromosomes, presumably through the splitting of the *S. officinarum* chromosomes. There is some evidence that the size of the plants in *Saccharum* is dependent on the chromosome number. Some of the new sugar-canes, with about 57 as the haploid chromosome number, obtained in the above experiments were crossed again with *S. spontaneum*. From these crosses robust plants were obtained with about 170 chromosomes in the somatic cells. Though these hybrids are useless for cultivation, it is suggested that recrossing them with the best varieties of *S. officinarum* might result in some hybrids of high value with very high chromosome numbers.

UPPER PALÆOZOIC OF KASHMIR.—"The Fauna of the Agglomeratic Slate Series of Kashmir" by the late H. S. Bion, with an introductory chapter by C. S. Middlemiss, is the subject of a memoir recently issued by the Geological Survey of India (*Pal. Ind.*, New Series, vol. 12). The discovery of this fauna fills in a gap in Himalayan geology between the Middle Carboniferous (Fenestella Shales) and the Panjal Trap which underlies the Permian. The geological structure of the district is described in the first sixteen pages and illustrated by a map and sections, the remaining portion (of the 42 pages) being devoted to the fauna. This consists almost entirely of Brachiopoda, *Spirifer* and *Productus* predominating. Exact specific determination has not been possible in some cases, while a few are defined as new species. The six photo-type plates

of the fossils have been executed in its usual admirable style by the Survey.

EXPERIMENTS IN UNDERTHRUSTING.—Mr. G. R. MacCarthy has carried out an important series of box-experiments to determine so far as possible the conditions under which underthrust faults and underturned folds might be formed, and to study the effects produced by a plastic supporting layer on the form of the structures developed by compression on the materials above it. His record of the results and conclusions reached appears in the *Am. Jour. Sci.* for July 1928. Underthrusts appear to be favoured by great plasticity of the substratum, upward-moving resistances, and unequal distribution of the overburden, the latter condition being particularly effective when the greater weight lies farthest from the point at which the active pressure is applied. Comparison of the results with the structures of actual mountain systems shows that a good case for underthrusting can be made out for the Rockies, but the problem of the direction of movement in the case of the Appalachian structures still remains indeterminate. Mr. MacCarthy points out that he has discovered no criteria by means of which underthrusts might be distinguished from overthrusts from an examination of the structures themselves. This is an important consequence of Newton's law of action and reaction which is frequently overlooked in geological descriptions.

RADIOACTIVITY AND ASTROPHYSICS.—The August issue of the *Journal of the Franklin Institute* contains an account of the presentation of the Franklin Medal to Prof. Walther Nernst, of Berlin, on May 16, and a communication from Prof. Nernst on the above subject, which, in the absence of the author, was read by Dr. I. Langmuir. Prof. Nernst considers that the source of the large amount of energy expended as radiation in the universe during the two thousand million years that the sun has existed must be sought for in radioactive processes. There must be elements which decompose more rapidly than uranium, and in so doing give off much more heat. They must have higher atomic weights and their radiations be of shorter wave-lengths than those of the known radioactive elements. The newly discovered cosmic radiation appears to be of this type, and probably five to twenty million volts would be necessary to generate it artificially. Astrophysics is, he considers, dependent more than any other science on daring hypotheses.

THE PATH OF SHORT RADIO WAVES.—In the *Bell Laboratories Record* for July interesting experiments by H. T. Friis, of the Bell Laboratories' research department, to determine the path of short radio waves are described. Two receiving antennæ placed a short distance apart receive an incoming wave at slightly different times which depend on the direction of reception. If the output of these receivers is separately connected to a pair of deflection electrodes of a cathode ray oscillograph, the pattern traced on the face of the tube by the stream of electrons will be different for each direction of the incoming wave. The experiments show that, when daylight extends over the entire transmission path, the horizontal angle of reception is small; the figure on the oscillograph being merely a straight line or a very thin ellipse. When the sunrise or sunset shadow wal lies across the path of transmission, the ellipses become quite pronounced. This seems to indicate a refraction of the short waves along the shadow wall. A very long series of observations would be required, however, before the exact law can be found. The patterns traced by the oscillograph change not only in shape, but also in size. The signal figures are sometimes complicated, but this is probably due to interference between two waves of different amplitude. Although the fading of short waves can be caused by rapid changes in absorption, it is probable that change in wave interference is by far the commonest cause of this phenomenon.

PHOTOCHEMICAL DECOMPOSITION OF HYDROGEN AZIDE.—The *Journal of the American Chemical Society* for July contains an interesting paper by A. O. Beckman and R. G. Dickinson describing experiments carried out on the photochemical decomposition of hydrogen azide, HN_3. In spite of its violently explosive properties in the liquid state, hydrogen azide vapour can be manipulated fairly safely at low pressures (*ca.* 13 cm.), and the gas was found to be decomposed by ultra-violet radiation from an aluminium spark, only wave-lengths shorter than 2400 A. being effective. The products of the decomposition were hydrogen, nitrogen, and ammonia in the form of ammonium azide, which appeared as a white solid. The relative proportions depended on the initial pressure and the *time* of illumination, and probably all the decomposition products were set free simultaneously. The analyses for hydrogen and nitrogen were carried out by means of a quartz fibre gauge, and a determination of the molecular weight was made, using the fibre and M'Leod gauges. This showed that hydrogen azide vapour consists of unassociated HN_3 molecules as was deduced by Dennis and Isham (1907) from a vapour density measurement.

ATOMIC WEIGHT OF CESIUM.—The accepted value for the atomic weight of cesium is 132·81, and is based upon the work of Richards and Archibald (1903), but Aston (1921), using the mass spectograph, found that cesium is a simple element with a mass of 133 ± 0·2. A redetermination of the atomic weight was therefore undertaken by the late Prof. Richards and M. Francon, and their results are given in the *Journal of the American Chemical Society* for August. The cesium chloride used was prepared from recrystallised cesium alums which were converted into the chloride and then into the perchlorate, when further recrystallisations were carried out. The chloride was re-formed by thermal decomposition of the perchlorate in a platinum boat, and the purity of the final product checked by spectroscopic examination. The results confirmed the value 132·81, the probable error being 0·012, and so the discrepancy between the chemical and physical determinations still remains.

HIGH FREQUENCY ALTERNATORS.—In the *English Electrical Journal* for July, a description is given of large power high frequency alternators which are used for induction furnaces. It seems that the difficulties formerly experienced in making high frequency alternators suitable for commercial purposes have now been overcome. The principle of using eddy currents for operating metal furnaces has been known for many years and offers many advantages. Unlike the use of furnace crucibles or electric arcs for melting, the eddy current system has the great advantage that no impurities can pass into the metal. The high frequency currents also set up a powerful circulation which causes intimate mixing of the ingredients, and consequently a highly uniform product. The magnetising coil is protected from the hot crucible by asbestos sheeting and sand packing. The 150 kilowatt furnace melts 450 lb. of steel in about 50 minutes, and the consumption of energy is at the rate of 750 kilowatts per ton. A photograph is shown of a 650 kilowatt machine which has a frequency of 1000. The over-all efficiency is more than 80 per cent, a result which a few years ago would have been considered quite impossible.

Radiovision in the United States.

THE use of the words 'radiogram' and 'radiophone' now seem fami[illegible] [illegible] *instrument by means of which we hear speech and music that has travelled through it, respectively. It seems natural, therefore, to call the seeing of pictures that have travelled through the ether 'radiovision.'* According to this analogy, 'television' would be restricted to pictures that have travelled through wires. In this sense we use the words telegraph and telephone.

We learn from Science Service, of Washington, D.C., that there are now 'movies' as well as speech and music in the ether. At certain times of the day, silhouettes are being sent out from the Jenkins Laboratory Station, 3XK at Washington, and later on half-tone pictures will be broadcast. Picture subjects and picture stories, in silhouette, are much easier for the beginner to pick up than real scenes. That they are of interest has been proved by the success of moving picture cartoons at the picture theatres.

In the early days of broadcasting, many amateurs and enthusiasts got much pleasure from building their own sets and searching the ether to try to locate some particular broadcasting station, their pleasure being comparable with that of a fisherman when he first gets into touch with a fish. There is no doubt that the search for visual radio will appeal to many. Receiving radiovision is more difficult than receiving ordinary broadcast, but it is well within the power of an amateur familiar with the ordinary valve sets. Receiving sets are not yet on the market, but C. F. Jenkins, the well-known pioneer in this art, through Science Service, is providing the readers of newspapers with full instructions as to the best way of making one with the help of paper matrices. The apparatus is called a radiovisor. In addition, a small alternating or direct current motor of about $\frac{1}{20}$ horse-power, a special neon tube, and an ordinary radio receiving set are required.

Radiovision is generally restricted to mean the transmission and reception of images of scenes and living persons by means of radio waves. It is probable, however, that considerable use will be made of moving picture films in this connexion. In radiovision, light and shadow are translated into variations of electric intensity, and by means of an aerial produce waves which can be broadcast and received in any home.

The microphone of the ordinary radio transmission picks up sound vibrations and translates them into electrical waves. In a similar way, the eye, which is a photo-electric cell, of the radio transmission station analyses the scene or motion picture into strips of fluctuating light. These strips of fluctuating light, generally 48 in number, are converted into waves and then reconverted into light, which illuminates for a small fraction of a second a screen. Fifteen complete still pictures are flashed on the screen per second. The same principle is adopted as that used in phototelegraphy. A scanning device is used to focus the photoelectric cell on each point of the scene in succession. In radiovision it is necessary to scan the whole scene in the fifteenth of a second.

In order to receive the pictures, four essential parts are necessary, a radio receiving set of good quality, capable of receiving the short wave-lengths used in radiovision, a neon lamp, a scanning disc, and a motor to rotate it. The neon lamp used in America is marked G—10 A.C. 110 volt. The scanning disc is 12 in. in diameter, and 48 holes forming a spiral are punched on it. It can be made of paper, held between two small gramophone records to stiffen it. A rubber friction disc driven by a motor bears on the back of the scanning disc.

Synchronism is obtained by moving the motor board nearer to or farther from the centre of the scanning disc. At first there are only black and white dots and dashes in the picture area, but when synchronism with the broadcasting station is obtained, the picture suddenly appears when the lamp is looked at through the flying holes of the scanning disc. At this speed the motor is running at 900 revolutions per minute. When the picture ends, the picture frame becomes pink; the radiovisor is then switched off and the loud-speaker switched on to listen to the announcer. From 3XK the pictures appear in black silhouette on a pink ground.

International Congress of Mathematics at Bologna.

THE International Congress of Mathematics was held this year at Bologna, on Sept. 3–Sept. 10, under the presidency of Prof. S. Pincherle. In view of the chequered history of these congresses, it is interesting to note the names and countries of the vice-presidents. They include Profs. De La Vallée Poussin (Belgium), Hadamard (France), Hilbert (Germany), W. H. Young and J. C. Fields (Britain and Dominions), Veblen (U.S.A.), Terradas (Spain), Sierpinski (Poland), H. Bohr (Holland, Denmark, Scandinavia), N. Lusin (Russia), and S. Kakeya (Japan).

In a sense this was the first congress of a really international character since the War, and for this reason, if for no other, it was a great pity that England, from the point of view of numbers, was so poorly represented that the matter was freely commented upon.

The first International Congress was held at Zurich in 1896, followed at regular intervals of four years by conferences until they were interrupted by the War. After the War, an attempt was made to renew the periodic sittings, but mathematicians, despite the universality of appeal of their subject, were unable to free themselves from the bondage of war psychology, and representatives from the countries of the Central Powers were at first deliberately excluded. Two conferences have been held with this restriction, one at Strasbourg in 1920 and the other at Toronto in 1924. At the conclusion of the latter, a resolution was carried expressing the view that the period of exclusion should be terminated. Such a resolution was not likely in itself to be successful in drawing once more within the ambit of an international body the powerful group of German mathematicians without whose co-operation such a conference was certain to be ineffective. The transition on this occasion was made the more easy and certain by the fact that the invitations to Bologna were sent out by the *University* of that town without regard to nationality.

The result was that although certain German university representatives were conspicuous by their absence, other schools, Göttingen for example, appeared in such force, both of talent and of numbers, as to exert an almost dominating influence on the gathering. To judge from numbers, appearances suggested that Britain and not Germany had been the excluded country. Out of nearly eight hundred mathematicians,

British members totalled scarcely more than a score, and among nearly four hundred contributions, papers by English mathematicians were few and far between. The public addresses, however, were fully international in character: they were delivered, among others, by D. Hilbert on "Problems of Mathematical Logic"; by J. Hadamard on "The Development and the Scientific Rôle of Functional Calculus"; by E. Borel on "The Calculus of Probability and the Exact Sciences"; by O. Veblen on "Differential Invariants"; by W. H. Young on "Mathematical Methods and Limitations"; by V. Volterra on "The Theory of Functions applied to Problems of Heredity"; by H. Weyl on "Continuous Groups"; and by T. von Kármán on "Mathematical Problems in Modern Aerodynamics."

In the main, the interest of members appeared to be centred on the pure rather than on the applied side of mathematics, and this was reflected in the nature of the communications made. From among British mathematicians present, papers were read by L. J. Mordell, D. Wrinch, H. Levy, E. T. Whittaker, H. W. Turnbull, L. M. Milne-Thomson, and J. C. Fields.

Nothing was spared by the Italian Government, the Municipal authorities, and the University to make the stay of the members as pleasant and attractive as possible, and numerous valuable facilities were freely granted to delegates. The history and architecture of Bologna were explained in book and brochure, the museums and art galleries thrown open, and excursions conducted to points of interest.

The final sitting was held at Florence, when it was arranged that the next conference, in 1932, should be held in Switzerland. If the International Congress at Bologna does not record any epoch-making discovery in mathematics, it is at any rate likely to mark, rather late, it is true, the definite termination of a state of misunderstanding among mathematicians.

"Nous osons affirmer," said Prof. Pincherle in his presidential address, "que le souvenir de cette réunion sera une pierre miliaire dans l'histoire du développement des rapports scientifiques : nous osons croire qu'elle ouvre une série nouvelle de Congrès, où les anciennes mésintelligences seront oubliées, et où les savants de tous les pays marqueront périodiquement les progrès obtenus dans ce domaine idéal qui embrasse les plus hautes et les plus délicates associations de la pensée, et qui trace à la technique les directions à suivre pour contribuer, par les voies les plus rationnelles, au bien-être de l'humanité."

Oxford Meeting of the Association of Special Libraries and Information Bureaux.

THE Association of Special Libraries and Information Bureaux (Aslib) held its fifth successive annual conference on Sept. 14–17 in New College, Oxford. During the past year it has been registered as an incorporated body, and the membership has grown from 311 to nearly 400; but a higher rate of increase will be necessary in future if the Association is to become self-supporting. In addition to other tasks before it, the Association must at once proceed to collect material for keeping up-to-date and enlarging the very useful Aslib Directory (of Sources of Specialised Information) which it published early this year, thanks to the generosity of the Carnegie United Kingdom Trustees.

SCIENTIFIC AND TECHNICAL ABSTRACTS.

One of the chief functions of the Association is to bring together workers in different branches of learning for the discussion of common problems. Abstracts are of common concern, and the paper which was read by Dr. W. Rosenhain will serve to focus attention upon the defects of present systems, which are too indiscriminate and uncritical, and result in much waste of time.

In Dr. Rosenhain's view, a good system should provide a 'reasoned index' of all published literature; it should serve as a guide to the more important publications; and it should act as a 'filter' to obviate the reader clogging his mind and wasting his time on a mass of profitless material. This index should be divided into three groups: (*a*) abstracts of really important papers, which should be critical and not too brief; (*b*) abstracts of less-important papers; and (*c*) abstracts of papers of comparatively little value. Abstracts in groups (*b*) and (*c*) should not as a rule exceed a three- or four-lined précis of the contents of a paper, but the critical review-abstracts in group (*a*) should direct attention to doubtful statements, to work done by inexperienced authors or by methods too crude to be exact, and to work which is purely repetitive.

Such a system could only be implemented by wide co-operation among all bodies concerned with abstracting in a given country, but preferably on an international basis. A central abstracting bureau would have to be set up that would command the services of a body of able editors, referees, review-abstracters, and competent indexers. The financing of such a scheme should not be insuperable, as much money would be saved by abolishing present wasteful methods. Certain bodies could not afford to abandon their abstracts because of the revenue which they bring in, but they could draw their supply from the central bureau and acquire from it the sole right of publication. The discussion upon this paper disclosed much opposition to the idea of critical abstracts, and it was suggested that criticisms should be supplied in the form of review articles or reports published at a later date.

PRESERVATION AND REPRODUCTION OF PRINTED MATTER.

In view of the probability that much of the paper used to-day is unlikely to last more than forty or fifty years, the durability of printed matter is a subject that concerns all societies which issue publications, as well as publishers of 'books that are books.' Thirty years ago the Royal Society of Arts issued a report on the deterioration of paper, embodying the findings of a special committee appointed by it; these findings are still applicable to-day. Durability of paper is determined by the kind of cellulose employed, by the treatment meted out to it in the mill, and by the quality and quantity of rosin, alum, etc., used in the manufacture. The best paper is made of cotton or linen rag that has not been over-boiled or over-bleached; it should be free from 'loading,' from colouring matter other than mineral colour, and from rosin. Such a paper is highly resistant to light and heat, and will keep, if properly stored, for hundreds, if not thousands, of years. Following 'rag' papers in order of durability are papers made of wood-cellulose or chemical pulp, esparto and straw celluloses, and mechanical wood pulp.

A good paper made of chemical pulp is, however, better than a rag paper that has been badly made, and according to Mr. N. Parley, who introduced this subject, a paper composed of equal parts of rag and chemical pulp should, if properly manufactured, last at least 400 or 500 years; and it should not cost

more than twice as much as the average book-papers of to-day. On the proposal of Mr. Parley, the Association passed a resolution (a) endorsing the recommendations of the committee of experts appointed by the International Committee on Intellectual Co-operation that the attention of governments be directed to the necessity for using documents and printed matter of permanent value, and only such papers as are manufactured according to given specifications; (b) asking H.M. Government to consider the establishment of a testing station to fix standards of durability for papers and other writing materials, and (c) to consider the advisability of enforcing by statute the printing of books, etc., for the copyright libraries on papers of approved durability.

In a second paper, on the reproduction of books and manuscripts, Mr. Parley urged the virtues of the recently introduced Replika process, which he claimed is superior to most other processes now in use. Collotype remains supreme where tone has to be reproduced, but it is relatively very expensive, and 'photostat' is economical only when a few copies are required. Replika is a combined printing and photographic process, which involves the use of light zinc or aluminium plates and accurate machinery employing the rubber blanket for printing. It is said to be particularly serviceable for reproducing extracts from transactions of learned societies, with or without size reduction.

AGRICULTURAL INTELLIGENCE SERVICES.

With the object of evoking a discussion among agricultural research workers, Dr. E. H. Tripp read a paper dealing with the informational aspects of agricultural research. The complexity and extremely wide geographical distribution of agricultural research, with its ever-increasing volume, demand not only organised attack of problems on a wide front, but also organised preparatory or intelligence work. Intelligence departments, staffed with trained scientific workers, are becoming increasingly necessary as research work increases in volume and importance, and the functions of 'searcher' and 'researcher' tend to become more distinct.

Intelligence facilities for agricultural research are not good: not only are adequate subject-indexes lacking, but also libraries containing agricultural collections are for the most part small and widely dispersed throughout the country. It was suggested that each small library should attempt to accumulate a complete collection of the literature of a special branch, leaving Rothamsted to aim at a complete general collection. Every special library should command the services of at least one assistant conversant with the special subject with which the library deals. Librarianship is not enough; one must have special knowledge. The intelligence worker, whether he be in an information bureau or special library, must also have a good command of the English language, and of at least two foreign languages, of which German must be one. Intelligence work offers a good opening for some of our scientific unemployed.

INDEXES TO PERIODICALS.

An informal discussion on the indexes of technical journals was opened by Mr. H. H. Johnson, editor of *Engineering*, whose contention that existing types of indexes are not only too diverse but also for the most part inadequate, was heartily supported. A resolution was passed asking the Council of the Association to appoint a special committee to consider practicable and economical methods of improving the indexes and lists of contents of scientific and technical periodicals.

University and Educational Intelligence.

DR. W. T. H. WILLIAMSON, senior assistant lecturer in agricultural chemistry at the Edinburgh and East of Scotland College of Agriculture, has resigned, on appointment as Director of the Chemical Section of the Egyptian Ministry of Agriculture at Cairo, in succession to Mr. W. S. Gray, who died on Aug. 31.

AN interesting programme of University Extension Lectures for the coming session has just been issued by the University of London, South Kensington. In addition to the courses which will be delivered in the City, lectures will be given at about fifty local centres in different parts of London and the suburbs, covering various periods and aspects of literature, geography, painting, music, history, science, architecture, and economics.

IN the Aeronautics Department of the Imperial College of Science and Technology are conducted regular courses of advanced study in aeronautical science lasting one or two years. A syllabus is given in the Department's pamphlet for the session 1928–29 of a one-year course in design and engineering and in meteorology, which qualifies for entering upon a further course in aeronautical research. The Department was established in pursuance of the recommendation of the Committee on Education and Research in Aeronautics, which reported to Parliament in 1919 that the Imperial College should become the central school for advanced study in this subject. It is under the direction of Prof. Leonard Bairstow, and is, in the main, a school for graduates. Among institutions in which provision for undergraduate work in aeronautical engineering is made are the East London College and the Northampton Polytechnic Institute. The former offers a three years' course in aerodynamics and aeroplane design for students proposing to take the London B.Sc. (Eng.) degree examination. At the Polytechnic, aeronautical engineering is one of five branches (the others being civil, mechanical, electrical, and electrical communication) in which candidates for the College Diploma, with or without the London B.Sc. (Eng.) degree, specialise in the third and fourth years of their course.

WE have received from the London County Council's Education Offices a handbook for the session 1928–29, giving particulars of the Council's admirably abundant provision of evening lectures and classes for teachers. The scheme, which is intended to be self-supporting by means of small fees, is designed to bring London teachers into touch with the latest developments in educational methods, and to give them opportunities of hearing leading authorities in various branches of learning and on current questions of importance. That teachers appreciate the provision thus made for their intellectual recreation and improvement is shown by the fact that last year the entries exceeded 14,000. The fees average less than a shilling a lecture for teachers in London and certain other privileged areas. Under the heading of science appear notices of courses of lectures by Prof. Winifred Cullis on food and health; by Dr. Ralph Williams on hygiene for boys' schools; by Prof. C. A. Edwards, Principal of University College, Swansea, on metals and their alloys; by Prof. C. R. Darling, on science in the home; and several others. The Director of the Science Museum will arrange a series of three weekly lectures and demonstrations on the Electrical Engineering Collection at the Museum at South Kensington. Several scientific societies are co-operating by placing at the Council's disposal for distribution to teachers a certain number of tickets of admission to their ordinary meetings.

Calendar of Customs and Festivals.

September 30.

THE COURT OF FOOLS.—In the year 1381, at Cleves, "on the Day of St. Cumbert" was instituted an "Order of Fools" of which it was ordained that a court lasting seven days should be held at Cleves in each year on the first Sunday after Michaelmas, the time to be passed in conviviality and good fellowship. The members were to wear a fool in silver or embroidery on their coats under penalty of a fine, such fines to go to the poor, and amity was to prevail among them under pain of expulsion from the Court.

Another Society of Fools was instituted in Poland, also in the fourteenth century, but here the qualification was some act or habit of outstanding folly, according to the character of which office in the society was bestowed; for example, a man inordinately fond of dogs was made master of the hunt. The society rapidly assumed large proportions.

October 1.

At Kidderminster the inauguration of the annually elected magistrates used to take place on the first Monday after Michaelmas. The town hall bell gave the signal for the 'lawless hour,' when the people assembled in the streets and cabbage stalks and other missiles were flung about. At the end of the hour the bailiffs elect and Corporation in their robes with a band visited the retiring magistrates, and then quantities of apples were thrown from the windows of their houses.

October 2.

GOOSE FAIR.—Once an annual fair at Nottingham for the sale of geese from the fens of Lincolnshire. The Mayor of Nottingham customarily gave a feast of roast goose on the last day of his office. The fair will be held this year for the last time. A local festival known as 'Goose Fair' was held at Great Crosby, near Liverpool, each year, and coming at the end of the harvest served as the harvest home.

October 6.

ST. FAITH'S DAY.—A curious custom forecasting marriage is recorded from the north of England. Three maidens or widows share equally in the making and baking of a cake, each turning it three times in the cooking. When done, it is cut into three portions, and each divided into nine slices. Each slice must be passed through the wedding ring of a woman married at least seven years. Each then eats her nine slices of cake as she goes to bed, repeating a verse. She sleeps with the ring suspended above her bed and dreams of her future husband.

THE MAYOR OF MYLOR.—At Penrhyn in Cornwall, when the nuts were ripe, a nutting day was held in late September or early October. The rabble of the town went out to the woods early in the morning and gathered nuts, returning with green boughs. In the meantime the journeyman tailors repaired to the adjacent village of Mylor, where they elected one of their number, usually the wittiest, as 'Mayor of Mylor.' He was then carried back to Penrhyn in a chair shaded with green boughs in a procession headed by stout fellows with cudgels, torch bearers, two 'town sergeants' in cocked hats and official gowns, but bearing cabbages instead of maces, and the nutters in the rear. The procession marched to the town hall, where the 'mayor' made a burlesque speech outlining his 'policy.' The day ended with fireworks and bonfires on 'The Green' and 'Old Wall.' There was a popular tradition that a clause in the town charter required the mayor of the town to yield up his authority to the 'Mayor of Mylor' on this night, and to allow the use of the official insignia of the town sergeants.

Similar mock mayors were elected in other parts of Cornwall. At St. Germans on May 28 a mayor was elected who was drawn round the boundaries in a cart. At Bodmin at the end of July a 'Mayor of Halgaver' was elected who dealt with minor and imaginary offences.

HARVEST.—Although the 'corn baby' represents the corn spirit, that spirit is not necessarily withdrawn from the remainder of the crop by its reservation. The sacrosanct character of the crop is unimpaired, and it is still dangerous to the devotees of the corn god: hence the Harvest Home and the first-fruit ceremonial. In the former the agriculturist does not merely rejoice at the gathering of the crop; he enters into a solemn communion with the deity by a sacrificial meal of which the substance of the deity is the material. The first-fruit ceremonies, in which an offering of the crop is made to the deity, remove the taboo arising from the sanctity which renders it dangerous until that quality has been neutralised. The special sanctity of the first fruits is shown by the fact that when eaten they must be taken fasting, just as the Christian fasts before Communion.

In Sweden the grain of the last sheaf was baked in the form of a little girl, and was then distributed to be eaten by every member of the household, while at La Palisse in France, a man made of dough was carried on the last load and then preserved until the close of the vintage, when it was broken up and eaten at a feast. In Lithuania, two hundred years ago, the new corn was eaten at the beginning of December at an elaborate ceremonial meal to which every kind of crop contributed and of which every member of the household partook, while a cock and hen of the year were sacrificed as an offering to 'god' and 'earth.' The first-fruit festival of the Creek Indians—the principal festival of their year—involved complete provision of new clothes, new utensils and furniture, new fire, fasting, purging, purification, and an offering of the first fruits to the fire spirit before the new crops could be touched. It will be noted in the "yam custom" of Ashanti, described in NATURE, Sept. 1, p. 334, not only were portions of the new yams given to the spirits, but the whole country had to be purified before the new yams could be eaten (for further examples see Frazer, "Golden Bough," abridged edition, pp. 479 *sqq.*).

As a parallel among primitive peoples to the rejoicing and horse-play of the peasant's harvest home may be quoted practices among the pagan tribes of Borneo. The women take cakes of the sticky boiled new rice and cover them with soot. These they endeavour to imprint on the faces and bodies of the men, who endeavour to retaliate. Drinking of the liquor made from the new rice and feasting are followed by dancing, in which some of the women dress as men carrying *padi* pestles. In one dance a woman leads holding a dried head, her followers being women dressed in war-coats. Another dance represents the departure of the spirit, and is a dramatic representation by three performers of the death of one of them who is restored to life by the Water of Life, which is supposed to be brought from the country traversed in the journey to the land of shades.

Part of the harvest ceremonial is a form of divination or good luck ceremony with four water beetles which are placed in a large gong filled with water. From their movements the good or ill success of the next year's crops is foretold. The aid of Laki Ivong to bring the soul of the *padi* to their homes is invoked.

Societies and Academies.

PARIS.

Academy of Sciences, Aug. 13.—**A. Lacroix**: New observations on the lavas of the Marquesas and the island of Tubuai (Southern Polynesia). Complete analyses of 21 specimens are given.—**Eugène Slutsky**: A criterion of the stochastic convergence of ensembles of contingent values.—**Silvio Minetti**: An equality in the theory of integral functions.—**Henri Muraour**: The laws of combustion of colloidal powders.—**G. Valensi**: The action of nitrogen on manganese. Pyrophoric manganese, obtained by the distillation of its amalgam, heated in nitrogen under atmospheric pressure, absorbs quantities of the gas which are a function of the temperature. The experimental results are given as curves. The true composition of the manganese nitride is still unknown, but is certainly richer in nitrogen than the generally accepted Mn_3N_2.—**Eugène**: Annealing anomalies after cold hardening of copper and brasses.—**A. Travers** and **Sehnoutka**: The hydrated tricalcium aluminate. The existence of this compound has been doubted: by using very dilute solutions of potassium aluminate and calcium nitrate, fine needles are obtained which have the composition $Al_2O_3 \cdot 3CaO \cdot 21H_2O$. The *p*H of the solution must be maintained within close limits, 11·55 and 11·62.—**Bourguel** and **Rambaud**: The determination of the spatial configuration of two *cis-trans*-ethylenic isomers. A study of the isomeric tetra-methylbutenediols,

$$(CH_3)_2C(OH) \cdot CH = CH \cdot C(OH)(CH_3)_2.$$

The author's conclusions are opposed to those of Salkind.—**Antoine Willemart**: Contribution to the study of the coloured hydrocarbons of the rubrene family.—**P. Russo** and **Mme. L. Russo**: First geological observations on the northern Rif.—**A. Magnan** and **A. Sainte-Laguë**: The static equilibrium of fishes. A fish can remain a long time in the same place, apparently immobile. As a result of a kinematograph study of a black bass, it is shown that the fins are in continual motion, and the nature of the motion can be determined from the photographs.—**K. Toumanoff**: Concerning aspergillomycosis of bees. The experimental infection of bees by *Aspergillus flavus* is easily realised. Multiplication of the fungus inside the body of the insect is rare, at least with the strains employed in this research. It was proved that the sterilised filtrates from cultures of the fungus are toxic to bees.

Aug. 20.—**A. Lacroix**: New observations on the lavas of the Leeward Islands and the Society Islands. Complete analyses of fourteen rocks are given.—**G. Bigourdan**: The observatory, instruments, and observations of Delambre at the rue Sainte-Avoye.—**A. Cotton**: The automatic mounting of a concave grating by the method of H. C. Richards. The author's communication of Jan. 16 last was anticipated by H. C. Richards in 1912 (*Proc. Amer. Phil. Soc.*).—**Charles Moureu, Charles Dufraisse, and Léon Enderlin**: Researches on rubrene. The constitution of rubrene. A constitutional formula is proposed for rubrene, mainly based on the fact that on oxidation with chromic acid, *o*-dibenzoylbenzene is formed in considerable amounts. Willemart has arrived at the same formula by another method.—**H. Vincent**: Anticolibacillus serotherapy. The results of its use in acute or chronic infections with *Bacillus coli*. In cases of gangrenous appendicitis, complicated with perforation, or with local peritonitis, the anticolibacillus serum has proved a valuable aid to surgical treatment, and has effected rapid and unexpected cures in very grave cases. In suppurating pyelonephritis of coli bacillus nature (verified in the laboratory), the serum has proved very active in cases in which the usual treatment has proved ineffectual. Some examples are given in detail.—**Krawtchouk**: The convergence of some methods of the approximate integration of differential equations.—**N. Stoyko**: A case of equation of lighting in meridian passage observations. The corrections of the clock determined with the aid of the Bouty meridian telescope at the Paris Observatory, have shown a systematic deviation which depends on the lighting of the field of the telescope. An equation for correction is worked out.—**N. Kryloff**: A method for the approximate solution of the problems of mathematical physics.—**Vasilesco Karpen**: New researches on batteries contradicting the second law of thermodynamics. A description of experiments with a cell composed of graphite, caustic soda solution, platinised platinum. From the rate of change of the E.M.F. of this cell with temperature, the second law of thermodynamics implies a reaction between water freed from air and graphite or platinum. Such a reaction appears improbable.—**G. Vavon** and **Crajcinovic**: The hydrogenation of nitrobenzene by platinum black. The reduction of nitrobenzene by hydrogen in the presence of platinum black and benzaldehyde gives *N*-phenylphenylnitrone in quantities which prove that the greater part of the nitrobenzene on reduction passes through the stage of phenylhydroxylamine.—**Edouard Rock**: The facies of the Jurassic in western Morocco.—**E. Rothé, J. Lacoste,** and **Mlle. Y. Dammann**: Earthquakes in France in 1927. Seventeen well-characterised earthquakes were felt in France during 1927. The Central Plateau, Alsace, and the Vosges were more stable than during 1926. In the south-east there was one violent shock, causing damage in the Mont Ventoux region, but the seismic activity was mainly manifested in Brittany and Normandy.—**E. A. Martel**: The four deepest abysses (natural pits) in the world (Italy, 420 to 637 metres). A description of pits at Monte-Lessini, Montenero, and Fiume. The Bertarelli or della Harna abyss has been described in an earlier communication.—**V. Agafonoff**: Some red soils of Cochin-China.—**Mme. Hufnagel** and **de Nabias**: Does radium act upon insects in the course of their metamorphosis? Experiments with *Calliphora* and *Hyponomeuta* showed that exposure to the gamma rays of radium was without effect on development.—**Edm. Sergent, A. Donatien, L. Parrot, F. Lestoquard**: The biological conflict against bovine piroplasmosis due to *Theileria dispar*. Bovine theileriosis is a house disease: the tick which transmits it bites the horse; but this animal is refractory to the disease.—**C. Levaditi, P. Lépiene, and Mlle. R. Schœn**: The spirochæticidal properties of the element vanadium. Asterogenesis round particles of vanadium. Elementary vanadium, finely divided, and in suspension in olive oil, exercises a marked curative action in spontaneous spirochætosis and in experimental syphilis.

BRUSSELS.

Royal Academy of Belgium, July 7.—**P. Fourmarier**: The relations of the 'massif de la Vesdre' and the synclinorium of Dinant.—**E. de Wildeman**: Branching of the oil palm (*Elæis guineensis*). Branching in the oil palm is due either to the death of the terminal bud or to some disease which prevents its growth.—**Jean Pelseneer**: Radiation in generalised relativity.—**F. Dacos**: Note on the velocity of the α-particles.—**Alliaume**: The investigation of star streams.

SYDNEY.

Linnean Society of New South Wales, July 25.—J. R. Malloch: Notes on Australian Diptera (No. 15).—Genera and species in the families Sapromyzidæ, Sciomyzidæ, Borboridæ, Muscidæ, Calliphoridæ, and Tachinidæ are dealt with. Two genera, one subgenus, and ten species are described as new. (No. 16.) Deals with genera and species in the families Ortalidæ, Ephydridæ, Drosophilidæ, Sapromyzidæ, Calliphoridæ, and Stratiomyiidæ. One genus and nine species are described as new.—A. M. Lea: New species of Australian Erirhinides (Curculionidæ). The paper deals with some small weevils of the subfamily Erirhinides, of which 42 species are described as new, the most interesting of these being the species of *Glaucopela* which was taken in large numbers from the nest of a bird at Ooldea in South Australia.—A. S. Le Souef: Notes on four little-known species of kangaroos. In the genus *Macropus*, which embraces the kangaroos, there are eight species and eleven more or less well-marked subspecies. Owing to lack of material, several of those are little known. The present paper gives more definite information about the Black-faced, Hagenbeck's, Bernard's, and the Tasmanian kangaroos.

Royal Society of New South Wales, Aug. 1.—T. H. Harrison: Brown rot of fruits and associated diseases in Australia (1). History of the disease and determination of the causal organism. Brown rot of deciduous fruits was introduced into Australia in the nineties of last century, and is now present in most temperate fruit-growing regions of the south-eastern fringe of Australia, but absent from South Australia and Western Australia. Comparative cultural and inoculation experiments, conidial germination, and taxonomic features of both conidial and apothecial stages, are recorded in detail. It is concluded that *Sclerotinia fructicola* (Wint.) Rehm. is the organism responsible for brown rot in Australia and New Zealand.—R. H. Cambage: Acacia seedlings (Part 13). The seedlings are described of the following ten species of *Acacia*: *argentea*, *carsiella*, *confusa*, *ericifolia*, *harpophylla*, *homalophylla*, *horrida*, *linophylla*, *merinthophora*, and *mollissima*. In connexion with the vitality of seeds in sea-water, it was mentioned that a seed of *A. Farnesiana* and one of *A. melanoxylon* had germinated after having been immersed continuously in sea-water for seven and a half and ten years respectively.

Official Publications Received.

BRITISH.

International Geographical Congresses: a Brief Account of their Origin, History and Proceedings. By Colonel Sir Charles Close. (Reprinted for the Members of the International Geographical Congress, London and Cambridge, 1928.) Pp. 17. (London: Royal Geographical Society.)

University of Liverpool: Tidal Institute. Ninth Annual Report, 1928. Pp. 7. (Liverpool.)

Philosophical Transactions of the Royal Society of London. Vol. 227, Series A. 652: The Analysis of Tidal Observations. By Dr. A. T. Doodson. Pp. 223-279. (London: Harrison and Sons, Ltd.)

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Royal Commission on Agriculture in India, Vol. 14. Appendix to the Report. Pp. vi+432+11 maps. (London: H.M. Stationery Office.)

The Journal of the Institute of Metals. Vol. 39. Edited by G. Shaw Scott. Pp. xii+814+43 plates. (London.) 31s. 6d. net.

Journal of the Royal Statistical Society. Vol. 91, Part 3. Pp. xii+462. (London.) 7s. 6d.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1141 (Ae. 310): The Determination of the Horsepower Height Factor of Engines from the Results of Type Trials of Aircraft. By J. D. Coales and A. L. Lingard. (T. 2520-I.C.E. 617.) Pp. 8+7 plates. 6d. net. No. 1143 (Ae. 311): The Structure of Vortex Sheets. By A. Fage and F. C. Johansen. (T. 2501.) Pp. 19+8 plates. 1s. net. (London: H.M. Stationery Office.)

The Hundred and Sixth Report of the Commissioners of Crown Lands. Pp. 35. (London: H.M. Stationery Office.) 4s. net.

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 18, Part 2, August. Pp. 45-92+7 plates. (London: Dulau and Co., Ltd.) 10s. net.

Colony of Mauritius. Annual Report on Royal Alfred Observatory for the Year 1927. Pp. 8. (Mauritius.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1928–1929. Pp. 96. (Edinburgh.)

The Botanical Society and Exchange Club of the British Isles. Vol. 8, Part 3: Report for 1927. By G. Claridge Druce. Pp. 289-558+2 plates. (Arbroath: T. Buncle and Co.) 10s.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1156 (Ae. 321): On the Flow of a Compressible Fluid Past an Obstacle. By Dr. H. Lamb. (T. 2596). Pp. 5. 4d. net. No. 1158 (Ae. 323): The Effect of the Static Pressure Gradient on the Drag of a Body Tested in a Wind Tunnel. By H. Glauert. (T. 2601.) Pp. 12+1 plate. 9d. net. (London: H.M. Stationery Office.)

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-Third Session, 1928–1929. Pp. 426+xxviii. (Glasgow.)

Battersea Polytechnic. Technical College for Day Students, and Day School of Arts and Crafts: Calendar, Session 1928-1929. Pp. 47+12 plates. 3d. Domestic Science Department and Training College: Full Time Day Instruction, Afternoon and Evening Classes, Session 1928–1929. Pp. 34+8 plates. 3d. Department of Hygiene and Public Health, Session 1928-1929. Pp. 29+3 plates. 3d. Calendar of Evening and Afternoon Courses and Classes for Session 1928–1929. Pp. 80+11 plates. Free. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 8: "Blossom-Wilt" of Apple Trees, and "Wither-Tip" of Plum Trees, with special reference to Two Biologic Forms of *Monilia cinerea* Bon. By Dr. C. Boyle, M. Murphy and Dr. H. A. Cummins. Pp. 63-76+plates 3-5. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 2s.

Ninth Annual Report of the Ministry of Health, 1927–1928. (Cmd. 3185.) Pp. xviii+292. (London: H.M. Stationery Office.) 5s. net.

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Indian Lac Association for Research. Reports of the Committee and of the Director, Indian Lac Research Institute, Namkum, Ranchi, for the Year 1st April 1927 to 31st March 1928. Pp. ii+44. (Namkum, Ranchi.)

Journal of the Chemical Society: containing Papers communicated to the Society. August. Pp. iv+1989-2307+xii. (London: Gurney and Jackson.)

The Livingstone Lectures, 1927: The Evolution of the Physical Features of Sydney and the Blue Mountains. By Dr. W. G. Woolnough. Pp. 28. (Sydney, N.S.W.: Camden College.)

The Cawthron Institute, Nelson, New Zealand. Cawthron Lectures, Vol. 3. No. 1: A Popular Account of Evolution, by Dr. J. P. Lotsy; No. 2: Electricity and Matter, by Sir Ernest Rutherford; No. 3: Recent Advances in Astronomy, by J. T. Ward; No. 4: Athens, Florence and the Modern State, by Prof. A. J. Grant. Pp. 22+18+28+22. (Nelson, N.Z.)

London County Council. Lectures and Classes for Teachers: Handbook for the Session 1928–29. Pp. 84. (London.)

FOREIGN.

Union Géographique Internationale. Publication No. 3: L'Extension des régions privées d'écoulement vers l'océan. Par Emm. de Martonne et L. Aufrère. Pp. iv+197. Rapport de la Commission de l'Habitat rural. (Report of the Commission on Types of Rural Settlement.) (U.G.I., No. 1.) Pp. vii+130. Rapport de la Commission des Terrasses Pliocènes et Pléistocènes. (First Report of the Commission on Pliocene and Pleistocene Terraces.) (U.G.I., No. 2.) Pp. 123+2 planches. (Paris.)

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Cornell University Agricultural Experiment Station. Memoir 115: Some Relations of Green Manures to the Nitrogen of a Soil. By T. L. Lyon and B. D. Wilson. Pp. 29. Bulletin 461: Farmers' Co-operative Business Organizations in New York. By J. F. Booth. Pp. 123. Bulletin 466: Interrelationships of Supply and Price. By G. F. Warren and F. A. Pearson. Pp. 144. Bulletin 468: Whey Butter. By E. S. Guthrie. Pp. 12. (Ithaca, N.Y.)

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IV Congresso Internazionale di Navigazione Aerea organizzato dal Ministero dell' Aeronautica. Ufficio Aviazione Civile e Traffico Aereo. Roma 24-30 Ottobre 1927. Vol. 1: Resoconto Generale. Pp. 468. Vol. 2: Memorie; Sezione Navigazione Aerea; Sezione Turismo e Propaganda; Sezione Giuridica. Pp. 545+40 tavole. Vol. 3; Memorie; Sezione Tecnicale. Pp. 550+34 tavole. Vol. 4: Memorie; Sezione Scientifica ed Aerologica; Sezione Medica. Pp. 687+22 tavole (Roma: G. Bardi.)

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 4: Commercial Education in 1924–1926. By J. O. Malott. Pp. 33. (Washington, D.C.: Government Printing Office.)

Trinity College. A List of Books for a College Student's Reading: Being the Trinity Booklist. Edited by Prof. Harry Todd Costello. Second edition, revised. Pp. 116. (Hartford, Conn.: Trinity College.)

Ministero dei Lavori Pubblici, Consiglio Superiore. Servizio Idrografico. Carte Quinquennali della Precipitazioni atmosferiche in Italia. Fasc. 1: Quinquennio 1921–1925. A cura del Prof. Filippo Eredia. Pp. xii+84. (Roma.)

Department of Commerce: Bureau of Standards. Technologic Papers of the Bureau of Standards, No. 369: Transmissive Properties of Eye-Protective Glasses and other Substances. By W. W. Coblentz and R. Stair. Pp. 555-578. (Washington, D.C.: Government Printing Office.) 10 cents.

Scientific Papers of the Institute of Physical and Chemical Research. No. 153: A View on the So-called Hygroscopic Water of Clays. By T. Okazawa. Pp. 15-40. 45 sen. No. 154: A Fine Quantum Analysis of Certain Terms of Thallium, 1. By M. Kimura. Pp. 51-56. 20 sen. No. 155: Limits of Ultra-Violet Transmission of Certain Inorganic Compounds. By M. Kimura and M. Takewaki. Pp. 57-64. 20 sen. Supplement, Vol. 9, No. 6: On the Series Relations of the Neon Spectrum. By Y. Ishida. Pp. 8+1 plate. 10 sen. (Komagome: Iwanami Shoten.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 80. The Orthoptera of Montana. By Morgan Hebard. Pp. 211-306+2 plates. (Philadelphia, Pa.)

Comptes rendus de la Troisième séance de la Commission Géodésique Baltique réunie à Riga du 20 au 23 Mai 1927. Rédigés par Ilmari Bonsdorff. Pp. iii+159. (Helsinki: Kirjapaino-Oy, Sana.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1927. Pp. 28. (Weltevreden.)

Occasional Papers of the California Academy of Sciences. No. 15: Studies on Marine Ostracods. Part 2: External Morphology of the Genus Cythereis with Descriptions of Twenty-one New Species. By Tage Skogsberg. Pp. 155. (San Francisco, Calif.) 2 dollars.

Smithsonian Institution: United States National Museum. Bulletin 76: Asteroidea of the North Pacific and Adjacent Waters. Part 2: Forcipulata (part). By Prof. Walter Kenrick Fisher. Pp. iii+245+81 plates. (Washington, D.C.: Government Printing Office.)

Maryland Geological Survey. Kent County. Pp. 184+12 plates+8 maps. Queen Anne's County. Pp. 175+8 plates+2 maps. Talbot County. Pp. 177+8 plates+2 maps. (Baltimore, Md.: Johns Hopkins Press.)

Department of the Interior: U.S. Geological Survey. Bulletin 793: Economic Geology of the Castlegate, Wellington and Sunnyside Quadrangles, Carbon County, Utah. By Frank R. Clark. Pp. vi+165+22 plates. 75 cents. Water-Supply Paper 573: Surface Water Supply of the United States, 1923. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+259+ii. 40 cents. Water-Supply Paper 585: Surface Water Supply of the United States, 1924. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+185. 25 cents. Water-Supply Paper 587: Surface Water Supply of the United States, 1924. Part 7: Lower Mississippi River Basin. Pp. iv+123. 20 cents. Professional Paper 142-E: The Molluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner. Part 5: Tellinacea, Solenacea, Mactracea, Myacea, Molluscoidea. Pp. iv+185-249+iv+plates 29-36. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 67, No. 1. Pp. 103. (Philadelphia, Pa.)

Diary of Societies.

SATURDAY, SEPTEMBER 29.

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—J. R. Hutchings: The Brush Ljungström Turbine.

MONDAY, OCTOBER 1.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—Dr. G. E. K. Blythe: Pulverised Fuel in Theory and Practice.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Littlehampton).—*Oct. 1 to 6.*

Monday, Oct. 1, at 8.45 P.M.—Annual General Meeting, at the Beach Hotel.

Tuesday, Oct. 2, at 8.45 P.M.—Dame Helen Gwynne-Vaughan: Problems of Development in the Fungi (Presidential Address).

Wednesday, Oct. 3, at 8.45 P.M.—A. Smith and W. C. Moore: New and Interesting Plant Diseases.

Thursday, Oct. 4, at 8.45 P.M.—Col. C. T. Green: Fungi and their Haunts.

Friday, Oct. 5, at 5.30.—J. Ramsbottom: Lecture to Littlehampton Nature and Archæology Circle on Fairy Rings. (Open to members of the British Mycological Society.)—At 8.45 P.M.—Carleton Rea: Comments on the Finds of the Week.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (jointly with Chemical Engineering Group) (at Royal Society of Arts).—W. J. A. Butterfield: Road Surfacing Materials.

TUESDAY, OCTOBER 2.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Automobile Club), at 8.—L. H. Hounsfield: The Integrity of the Technical Man (Presidential Address).

WEDNESDAY, OCTOBER 3.

PHARMACEUTICAL SOCIETY, at 3.—R. R. Bennett: Inaugural Sessional Address and Presentation of the Pereira Medal.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. G. W. Monier-Williams: Polarimetric Determination of Sucrose in Milk and Sucrose Mixtures.—T. McLachlan: The Analysis of Sugar Degradation Products by Selective Fermentation.—Dr. W. R. Schoeller and E. F. Waterhouse: Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. XIII. A New Method for the Separation of Zirconium and Hafnium from Tantalum and Niobium.

FRIDAY, OCTOBER 5.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. J. Simpson: Interesting Details of Swiss Alpine Railways.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Society of Chemical Industry—London Section) (at Royal Society of Arts).—F. H. Rogers: Factory Floors.

SATURDAY, OCTOBER 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District Meeting) (at Town Hall, Stockport), at 11 A.M.

PUBLIC LECTURES.

MONDAY, OCTOBER 1.

GRESHAM COLLEGE (Basinghall Street), at 6.—G. C. Robson: The Nature and Origin of Life.

SATURDAY, OCTOBER 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. R. Ogden: The Recent Discoveries at Ur of the Chaldees.

SATURDAY, OCTOBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Animal Conquest of the Sea.

CONGRESSES.

SEPTEMBER 24–OCTOBER 6.

WORLD POWER CONFERENCE—FUEL CONFERENCE (at Imperial Institute). (For Programme see NATURE, Sept. 22.)

SEPTEMBER 28 AND 29.

FARADAY SOCIETY (in Physical Chemistry Laboratory, University of Cambridge).—General Discussion on Homogeneous Catalysis.

Friday, Sept. 28, from 2.30–4.30 *and* 5–7.15.—

Prof. T. M. Lowry: Introductory Paper. Some Problems in Homogeneous Catalysis.

Part I. General Relations.

C. N. Hinshelwood: Homogeneous Catalysis.

C. H. Gibson and C. N. Hinshelwood: The Influence of Nitrogen Peroxide on the Union of Hydrogen and Oxygen. A Problem of 'Trace Catalysis.'

H. Moureu: Catalytic Phenomena in the Tautomerism of certain α-Diketones.

Dr. E. K. Rideal: Negative Catalysis.

N. R. Dhar: (*a*) Ionisation in Chemical Change; (*b*) Negative Catalysis in Slow and Induced Oxidations.

F. Gill, E. W. J. Mardles, and H. C. Tett: Phosphorescence and Autocatalysis during Slow Combustion.

H. Baeckstroem: Negative Catalysis.

Part II. Intermediate Addition-Compounds and Chain Reactions.

J. Kendall and Lilian E. Harrison: Compound Formation in Ester Water Systems.

J. A. Christiansen: Report on the Theory of Chain Reactions.

M. Polanyi: Bromine Inhibition of Chain Reactions.

J. Boeseken: The Theory of Molecular Dislocation Applied to Homogeneous Catalysis.

Saturday, Sept. 29, 10 A.M.–1 P.M. *and* 2.30–4 P.M.

Part III. Neutral Salt and Activity Effects.

J. N. Brönsted: The Theory of Acid and Basic Catalysis.

Dr. H. M. Dawson: Catalytic Effects of Acids and Bases and the Influence of Inert Salts.

H. von Euler: Compounds between Catalysts and Substrates and their Reactivity.

H. Goldschmidt: On the Catalytic Activity of Hydrogen Ions in Ethyl Alcohol.

H. S. Harned and G. Åkerlöf: Investigations of Salt Action in Homogeneous Catalysis.

F. O. Rice and J. J. Sullivan: Keto-Enol Isomerism and the Mechanism of Homogeneous Reactions.

F. G. Soper: The Activity Theory of Reaction Velocity. The Rate of Interaction of a Chloroamine and Hydrobromic Acid.

OCTOBER 1–3.

INTERNATIONAL FEDERATION OF INTELLECTUAL UNIONS (at Prague).

Oct. 1.

C. P. Blacker: The Modern Conception of the World.—F. Dessauer: Der Geist der Erfindung.

Oct. 2.

H. de Man: Le rôle de la technique dans le domaine social.—A. Fontaine: La transformation d'État sous l'influence de la technique.

Oct. 3.

Jeanneret–Le Corbusier: Les formes nouvelles de l'art protique.—C. G. Jung: Das Seelenproblem des modernen Menschen.

OCTOBER 9–11.

FRENCH CONGRESS OF LEGAL MEDICINE (at Paris).—Prof. Balthazar: Expert Evidence in Social Questions.—MM. Charbonnel and Massé: Industrial Accidents, Comparative Results of External Methods and Osteosynthesis in the Treatment of Fractures of the Leg.—M. Duvoir: Professional Intoxication by Hydrocarbides.—M. Fribourg-Blanc: Anti-social Reactions in Epidemic Encephalitis.

SATURDAY, OCTOBER 6, 1928.

CONTENTS.

Life and Death.

MAN must have speculated on the meaning and source of life ever since a race of beings arose on this planet endowed with the power of reasoning, the particular form taken by his speculations depending on the stage of civilisation and culture reached. At all times there have been those—fewer now than even a century ago—who drew a sharp line of distinction between the living and the non-living, between the inorganic and the organic world ; but the advance of scientific knowledge has slowly broken down the barriers between the animate and the inanimate, first when it was discovered that organic substances, previously supposed peculiar to the tissues of living beings, could be prepared in the test-tube in exactly similar manner to inorganic compounds, until nowadays many confidently assert that the phenomena of life will be explicable in the terms of the more exact sciences. Others, more cautious perhaps, consider that though it may be possible to describe these phenomena in the terms used in mathematics, physics, or chemistry, yet such description will still not provide us with a final and complete explanation.

That the laws which govern the phenomena of life are undiscoverable, that the basis of life is some vital principle, the nature of which can never be known, is a position which few would hold to-day, leading as it does to a paralysis of the power of investigation, and refuted, as it is, by our rapidly increasing knowledge of these very phenomena. The fundamental distinction between the living and the non-living is that whilst it is possible to isolate the phenomena of the inorganic world, it is impossible to consider a living organism apart from its environment ; it is, in fact, its reactions and adaptations to changes in its surroundings which distinguish the living from the inanimate and form the basis of the science of biology.

What light, then, do the recent advances in chemistry and physics throw on the phenomena of life ? And how far are the laws of these sciences applicable to the reactions of living beings ? To a consideration of these questions Prof. Donnan applied himself in his recent evening discourse to the British Association at Glasgow. The investigations of physiologists early showed that organisms obey the laws of the conservation of matter and of energy. The energy for the heat produced and the work performed by a living being is derived from the energy value of the food consumed, by its oxidation in the presence of the

oxygen taken in during respiration, and it is easy to construct a balance sheet of the incoming and outgoing energy and show that there is no credit or debit balance. Again, plants and animals conform also to the second law of thermodynamics, so far as is known at present; it is the free or available energy of their environment which is the sole source of their life and activity, and the origin of this available energy is the radiation from the sun. If this radiation were in thermal equilibrium with the average temperature of the earth's crust, practically all life as we know it would cease, since the green plant would be unable to assimilate carbon dioxide and water by the absorption of free energy by means of its contained chlorophyll, and the synthesis to sugar and starch would fail to occur. This synthesis represents an increase in free energy, since starch will produce energy on oxidation, and would be impossible unless there were at the same time a compensating degradation of energy.

All living things live and act by utilising the free energy of their environment; the living cell, in fact, acts as an energy transformer. Thus some nitrifying bacteria oxidise ammonia to nitrous or nitric acid and so obtain the necessary energy to build up carbonic acid to sugar or protein; other microbes utilise the free energy of sulphuretted hydrogen and oxygen. Up to the present, all the energy transformations of the living cell so far investigated have been found to obey the second law of thermodynamics, so that all activity depends on the nature and amount of the free energy in the immediate environment, and this applies both to the organism as a whole as well as to its individual cells. If the blood-flow to the brain is stopped, the nerve cells soon cease to function and consciousness is lost; if the entry of oxygen into the lungs is prevented, all the cells of the body sooner or later cease to live.

In the investigation of living phenomena, it is essential to reduce the problems to their simplest terms and study each under controlled conditions; but it must not be forgotten that every action of a cell within the body has its repercussions upon the action of some other cell or cells, so that, having studied a series of isolated phenomena, it is necessary to find the influence each exerts upon the others, to synthesise the parts again into the whole. It is by the application of the laws and facts of physics and chemistry to the elementary phenomena that we are gradually arriving at an understanding of the whole. Whether these laws will suffice to describe all the phenomena or whether a new form of energy will be discovered, none can say.

Among living phenomena recently analysed, those of muscular contraction and the equilibrium between the red blood cells and the plasma are especially noteworthy. The energy of work is obtained from the rapid exothermic conversion of glycogen into lactic acid; when the contraction is over, the glycogen, the muscle's store of free energy, is replaced by the reconversion of the major part of the lactic acid into the polysaccharide, the necessary energy being obtained from the oxidation of the remainder. A balance sheet of the energy changes can be constructed, and it is found that the whole process obeys the known laws of physics and chemistry; that the heat given out or energy absorbed is the same as in the corresponding changes carried out in the test-tube; that there is no loss or gain of total energy. The equilibrium between the red blood cells and the plasma illustrates how one change in a system may set in motion a whole series of changes designed to compensate for the first and bring the system back again to its unstable equilibrium; the whole series of changes can be written in a set of precise mathematical equations; the effects of a given change can be calculated and, when examined experimentally, found to agree with those predicted. Thus each event depends on some preceding event, and the whole series follows exact laws; so far, no phenomena have been found to follow the laws of probability, though this is not to say that such may not be discovered in the future; but at present each event follows inexorably in the footsteps of those preceding and depends upon and is conditioned by them.

There is, however, always the possibility that events occurring in communities of cells such as compose one of the higher organisms, may not be really analogous to those taking place within a single cell, or that the laws governing the phenomena of the large molecules of which the cell protoplasm is composed may not apply to the behaviour of simple molecules, or atoms, or electrons. Sometimes it has appeared as though the movements of the latter might be due to chance rather than to some preceding event occurring in the neighbourhood; but even in the case of such phenomena it is sometimes possible, by application of the laws of chance, to predict the probability, or otherwise, of some future occurrence. It must also always be remembered that what appears to us a chance event may in fact be the sequence of some one preceding, although owing to our ignorance of the phenomena and our inability to repeat the required conditions, appearing to be quite unrelated.

The chief distinction between the inorganic world and life is that in living organisms structure depends on function, and that whereas the structure of the inorganic world may be looked upon as static, the structure of a living cell is dynamic. The cell consists of protoplasm surrounded by a membrane and containing a nucleus: the protoplasmic system of the cell body and nucleus exists in what is known as the colloidal state. Protoplasm has as the basis of its composition protein compounds; but fat-like substances, carbohydrates, salts, and water are also present in the cell. Each living cell acts as an energy transformer; on death it ceases to take up oxygen and other substances from the surrounding medium and to give out energy in one of its various forms. But at the same time it does not simply remain, so to speak, *in statu quo*, like a run-down machine; it disintegrates. In other words, its very structure depends on its being alive, and at the moment of death, this structure begins to fall to pieces; in fact, the cell is destroyed by certain enzymes present in it, which, at death, attack its structure and destroy it.

The reason why these enzymes do not break down the living cell must be because it is alive, and the solution of this problem would go far towards solving the mystery of life itself. It appears that the structure of the cell is chemico-dynamic, and depends on the supply of oxygen for its preservation. Thus the machine of a cell is totally unlike an inorganic machine, which is not destroyed, but simply fails to run, when the supply of fuel gives out. The equilibrium between the cell and its surroundings is thus not static but dynamic; death leads to an irreversible breakdown of structure and the final production of a static equilibrium. In this dynamic equilibrium lies the power of the cell to react and adapt itself to changes in its environment.

At the moment, such investigations throw little light on the origin of life upon this planet, but they do suggest that further research may bring us nearer to a solution of this problem. Astronomy teaches that the earth, thrown off like the other planets of our solar system from the sun under the gravitational pull of a passing star, and held by the sun's attraction in a revolving orbit, cooled down and finally acquired a solid crust, probably at least a thousand million years ago. Since then the water vapour in its atmosphere condensed to form seas and lakes and rivers, and living beings, plant and animal, appeared. Did spores of life, scattered or did life arise from inorganic matter already present on the earth's surface? The theory of 'Panspermia,' besides having to surmount many apparently insuperable obstacles, shuts the doors to all investigation of life's origin; on the other hand, if life arose upon the earth, it is permissible to speculate upon the conditions necessary for its appearance and upon the form or forms it first assumed.

From the fact that the nature and amounts of the inorganic salts in the tissue fluids reflect almost certainly the composition of the oceans a hundred million years ago, it appears justifiable to assume that life arose in the waters of this period of the earth's history. It is probable that the atmosphere at this time contained carbon dioxide and ammonia or sulphuretted hydrogen, so that certain bacteria could have flourished as they do to-day. But whence came the organic matter, the protoplasm, of their cell bodies? Now it has been shown that in the presence of light, moisture, and carbon dioxide, formaldehyde and sugar can be produced at the surface of certain inorganic compounds, such as nickel carbonate, so that it is easy to imagine how certain organic substances might have been produced from inorganic; and similar syntheses of other organic compounds may be found in the future when science discovers the necessary conditions. A further obstacle, however, now requires surmounting: the protein components of the protoplasmic system are optically active, and so far no asymmetric synthesis has been carried out in the laboratory, starting from symmetrical, optically inactive substances. Even when this difficulty is surmounted, as no doubt it will be in the future, the conditions necessary for the production of the complicated structure of the dynamic living protoplasm will have to be obtained.

It is always possible that the origin of life was an exceedingly rare fluctuation from the average of happenings in which organic material arose from inorganic, or structured organic from the structureless. The minute organisms of the filter-passing viruses are of the same order of size as many non-living colloidal particles, so that on the score of size there is no insuperable difficulty in the way of postulating some such origin for living beings. By patient investigation man will delve deeper and deeper into the heart of the mystery of life, possibly forging new tools of technique and reasoning in the process, but whether he will obtain such control of the conditions as to be able to see life arise from the non-living, or whether even it is possible to attain the necessary conditions in the world as we know it to-day, must be left to the future to decide.

Letters to the Editor.

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An Attempt to Accelerate the Rate of Radioactive Transformation.

DANYSZ and Wertenstein showed in 1915 (*Comptes rendus*, **161**, 784; 1915) that when uranium oxide is bombarded by the α-rays of radium, not one in five million α-particles is effective in changing an atom of U into an atom of UX_1. If we consider that with a layer of uranium containing 1 mgm. per cm.^{2} one α-particle in 20,000 penetrates to a distance less than 5×10^{-12} cm. from the nucleus, and that the emission of an α-particle from uranium seems to start at a distance greater than 5×10^{-12} *cm.*, it is surprising that the unstable radioactive atom shows itself so stable.

According to a theory put forward by Sir Ernest Rutherford (*Phil. Mag.*, Sept. 1927) the α-particles circulate round the nucleus as neutralised satellites. If external action brings about an α-transformation, this action must lead to the artificial break up of an α-satellite. Such a break up must take place in a spontaneous α-disintegration, but while in this case the two electrons go to the nucleus, the violent commotion in the artificial disintegration may lead to the escape of the electrons. If this really happens, a favourable collision of an α-particle with a radioactive nucleus may result in a triple (one + two β) transformation. This assumption would explain the negative results of the former work, for in the case of uranium bombarded with α-rays, a favourable encounter would result in the formation of an atom of U II and not of UX_1, as was previously assumed.

On account of the long period of U II the effect could not be detected unless there were an abundant formation of atoms.

In the case of thorium, however, the product formed after one α- and two β-transformations would be radiothorium with a period of only 2·02 years, and calculation shows that the limit of sensitivity in detecting the change Th–RaTh is about the same as for U–UX_1.

We therefore repeated Danysz and Wertenstein's experiment, substituting thorium for uranium, and we tried to detect changes in α-ray, and not β-ray, activity. We prepared three sources, each containing about 1 mgm. ThO_2 in a uniform layer 3 mm. × 7 mm. Such a layer is equivalent in absorption of α-rays to about 1 cm. air. The sources were covered with thin aluminium leaf to avoid loss of activity by escape of emanation, an effect which was, however, found to be negligible. Their α-ray activity was tested in a differential α-ray ionisation chamber connected with a Wilson electroscope. A difference of activity corresponding to 1/10 mgm. ThO_2 could easily be measured. One of the sources was used as a standard, the others were exposed for six days to the α-rays of radon. They were placed one on either side of a thin-walled glass tube (equivalent stopping power 1·5 cm.), containing initially 28 millicurie of radon. Each source received nearly half the total α-emission. After six days the sources were each compared with the standard. Within 2 per cent no change in activity could be detected.

The number of α-particles from radon and products which fell on each source during the time was $2{\cdot}2 \times 10^{14}$. 1 mgm. thorium with its products gives 27 α-particles per second, and 1/20 of this could be detected, so that if any radiothorium were produced by the bombardment, it gave less than 1·35 α-particles per second. For radiothorium, the disintegration constant $\lambda = \frac{1}{9{\cdot}2 \times 10^7}$ sec.$^{-1}$ and then follow five α-ray products of short life, so that the number of atoms of radiothorium corresponding to 1·35 α-particles per second is $\frac{1{\cdot}35}{5} \times 9{\cdot}2 \times 10^7 = 2{\cdot}5 \times 10^7$.

It appears that the upper limit of the probability of an α-ray collision producing an explosion of this type in the α-satellite is $\frac{2{\cdot}5 \times 10^7}{2{\cdot}2 \times 10^{14}}$; less than one in eight million.

H. HERSZFINKIEL.
L. WERTENSTEIN.
Radiological Laboratory, Warsaw.

The Recognition of a New Category of Structures in Spermatogenesis.

IN connexion with some work which Dr. Sylvia Wigoder and I are carrying out, it became necessary to re-examine the spermatogenesis of *Caria*. By chilling the Da Fano fluid (5° C.) it was possible to get extremely good and unshrunken preparations. These revealed a remarkable argentophile band on the ripe sperms (Fig. 1, PNB), which was easily traced back into the spermatid (Fig. 2, No. 13, PNG) in the form of a group of granules, which constituted in the later spermatid (Fig. 2, No. 14) a sort of coalescing network embracing the hinder part of the nucleus. This reminded me of similar structures already described in *Saccocirrus* (*Q.J.M.S.*, 1922, and Fig. 2, Nos. 1 and 2, PNB) and in a number of pulmonate mollusca (*ibid.*, 1919, and Fig. 2, Nos. 3 and 4, PNG, post-nuclear granules).

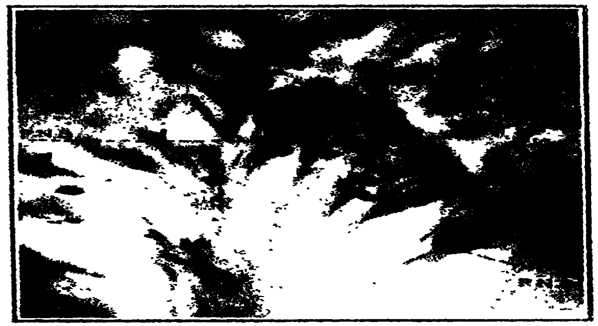

FIG. 1.

The finding of such undoubtedly homologous structures in an annelid, molluscs, and a mammal, made it likely that the post-nuclear system was universal in flagellate spermatogenesis, and the papers of Bowen have been consulted. It is impossible here to enter into all the work of Bowen, but in the pentatomid, *Murgantia* (Fig. 2, Nos. 5 and 6, PNB), Bowen has given a practically correct account of the post-nuclear system (his 'pseudo-blepharoplast'). In probably a number of cases Bowen has mistaken the post-nuclear body for a centrosome or middle-piece. In the urodele (Fig. 2, Nos. 7, 8, and 9), for example, it seems likely that the 'middle-piece' of Meves and Bowen (PNG) is the post-nuclear apparatus. In *Cincindela*, the post-nuclear band, Bowen's chromatinic 'chromatic

plate,' is very clear (Fig. 2, No. 10). The most interesting case among Bowen's forms is *Lepisma* (Fig. 2, Nos. 11 and 12). In the stage of Fig. 2, No. 12, Bowen calls the acrosome (A) a 'centrosome,' and the post-nuclear body (PNG) the 'acrosome,' and on the strength of this error refers to the *Lepisma* sperm as an 'atypical flagellate type' (*Jour. Morph.*, 1924; *Anat. Record*, 1925). No other sperm is known which has a centrosome at its tip, and I am quite certain that

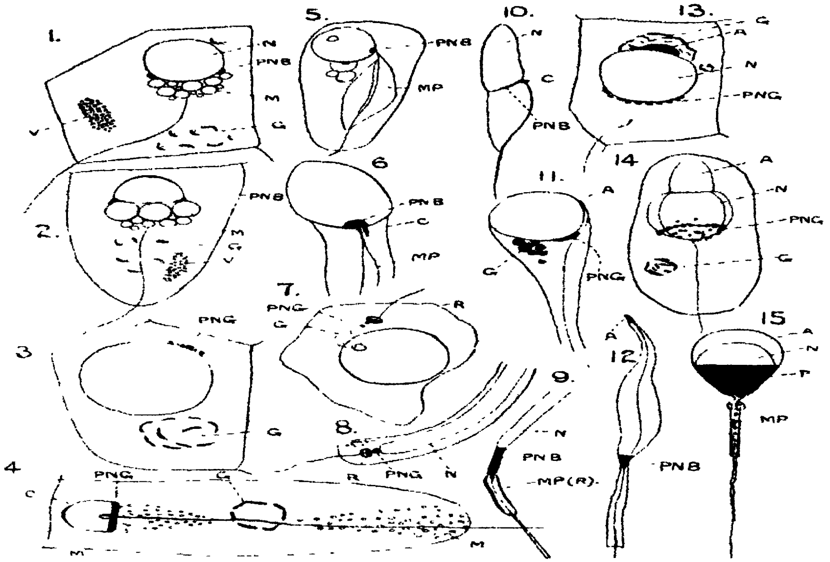

FIG. 2.—A, acrosome. C, centrosome. G, Golgi apparatus. M, MP, middle-piece or mitochondria. N, nucleus. P, PNB, PNG, post-nuclear system. R, ring centrosome. V, vacuolar system. 1, 2, *Saccocirrus*; 3, 4, pulmonate molluscs; 5, 6, *Murgantia*, bug (Bowen); 7, 8, 9, amphibian (Bowen); 10, *Cicindela*, beetle (Bowen); 11, 12, *Lepisma*, silver fish (Bowen); 13, 14, 15, *Cavia*.

Bowen is wrong in his interpretation. In fact, examination of Bowen's figs. 92-118 of his paper in the *Journal of Morphology*, will show that the *Lepisma* spermatid is not abnormal.

Summarising these results, it may be stated that the nucleus of the ripe flagellate spermatozoon is attached to the centrosome and middle-piece by a special structure which I call the *post-nuclear body*. This often forms a flattened cup, in which the hinder part of the nucleus fits, as in mammals like *Cavia*. Post-nuclear bodies are known in annelids, molluscs, insects, amphibians, and mammals, and have been consistently confused with centrosome or middle-piece by various cytologists, and even with the acrosome, as in *Lepisma* (Bowen).

J. BRONTË GATENBY.

Trinity College, Dublin,
Sept. 10.

Interpretation of the Atmospheric Oxygen Bands; Electronic Levels of the Oxygen Molecule.

THE known spectrum of the neutral oxygen molecule consists of two well-known band systems, both of which occur in absorption, and arise from the normal state of the molecule. One of these systems, known as the Schumann bands (also known in emission as the Runge bands), lies in the ultra-violet near λ1800, and corresponds to a very intense absorption. The other, known as the atmospheric absorption bands, lies at the long wave-length end of the visible solar spectrum; it is only moderately absorbed in the whole thickness of the earth's atmosphere, and this very weak absorption shows that the upper electronic state of these bands must be classed as a metastable level.

As I have pointed out elsewhere (*Phys. Rev.*, **32**, 213; 1928), the Schumann-Runge bands almost certainly correspond to a $^3S \rightarrow {}^3S$ transition. The structure of the atmospheric bands has been studied by many investigators, but no satisfactory interpretation of the observed structure has been given. In a forthcoming paper in the *Physical Review* I shall, however, show that the structure, with the exception of certain exceedingly weak series (A' band), can be completely explained if the upper electron level is a ^1S level.

In a recent paper (*l.c.*) I have made tentative assignments of electron configurations for a number of diatomic molecules. For the ^3S normal state of the oxygen molecule the configuration assigned is $(1s^{\sigma})^2\ (2s^p)^2\ (2s^{\sigma})^2\ (3s^p)^2\ (2p^p)^4\ (3s^{\sigma})^2\ (3p^p)^2$; the meaning of the symbols is explained in the article cited. As is shown there, this same configuration should also give rise to a ^1S and a ^1D state.

These three states ^3S, ^1D, ^1S may be compared with the three states ^3P, ^1D, and ^1S expected for a carbon atom with the configuration $(1s)^2\ (2s)^2\ (2p)^2$, or an oxygen atom $(1s)^2\ (2s)^2\ (2p)^4$. The analogy is, however, by no means so close as the symbols suggest, since, for the atom, S, P, D refer to the quantum number l, but for the molecule, to σ_l. Nevertheless it probably holds for the following points: (1) one expects the molecular levels ^3S, ^1D, ^1S to lie in an energy range of a few volts, the energy increasing in the order given, as for the atomic levels ^3P, ^1D, ^1S; (2) the two upper levels ^1D and ^1S of the molecule should be metastable like the analogous levels of the atom, and for similar reasons.

It now seems reasonable to identify the upper, ^1S, level of the atmospheric oxygen bands, lying at 1·62 volts above the ^3S normal level, with the *predicted* ^1S level. The exceedingly low absorption coefficient for the transition $^3S \rightarrow {}^1S$—much lower than can be completely accounted for by the fact that this is an inter-system transition—is in agreement with the expected metastability of the ^1S level. Also the interval between the ^3S and ^1S levels is of about the expected magnitude.

If the above explanation is correct, we may expect to find a ^1D level of O_2 between the ^3S and ^1S levels, and may perhaps be able to find a new system of atmospheric absorption bands in the infra-red corresponding to the transition $^3S \rightarrow {}^1D$.

R. S. MULLIKEN.

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New York University.

The Dissociation Energy of Nitrogen.

IN a recent very interesting letter to NATURE (Sept. 1, p. 313) E. Gaviola reports the occurrence of the NH-band λ3360-70, using Wood's arrangement for the optical excitation of mercury vapour, when nitrogen and hydrogen are admitted. From the fact that the intensity of the band is proportional to the square of the intensity of the exciting light, Gaviola concludes that the atomic nitrogen is formed by three-body collisions of N_2-molecules with two excited mercury atoms. It follows that the dissociation energy of nitrogen is less than 9·8 volts, whereas Sponer (*Zeits. f. Phys.*,

34, 622; 1925), according to her interpretation of the nitrogen afterglow, has calculated the value 11·4 volts. Moreover, the latter value is confirmed by a rough extrapolation of the curve for the frequency of vibration in the normal state of the nitrogen molecule (cf. H. Sponer, *Zeits. f. Phys.*, **41**, 611; 1927).

In this connexion it is perhaps interesting to note that a dissociation energy in accordance with Gaviola's experiments results also from the following considerations: in a recent paper "On the structure of the negative nitrogen bands" (*Ann. d. Phys.*, **86**, 189; 1928), I was able to extend this band system considerably; in consequence of which it was possible to extrapolate the curve of the vibration frequency much more accurately than was possible before. The value for the heat of dissociation from the normal state of the molecular ion which results according to the method of Birge and Sponer (cf. *Phys. Rev.*, **28**, 259; 1926) is the same as that derived by Birge and Sponer themselves, namely, 9·1 volts. The value for the dissociation energy from the excited state, however, is found to be 3·7 volts. This, added to the electronic excitation energy of the excited state (3·2 volts), gives 6·9 volts. It is very remarkable that this value is definitely less than the former (cf., *l.c.*). Therefore it is necessary to suppose that the result of a dissociation in the electronic excited state is a normal atom and a normal atomic ion. If, now, according to the formula

$$I_m + D' = D + I_a,$$

where now $D' = 6{\cdot}9$, $I_m = 16{\cdot}7$, $I_a = 14{\cdot}5$ (cf. Birge and Sponer, *l.c.*), the dissociation energy of the normal molecule is calculated, there results 9·1 volts, whereas with 9·1 volts as dissociation energy of the molecular ion ($D' = 7$) the value 11·3 volts which Birge and Sponer have adopted is obtained for D. The former value is quite in accord with Gaviola's observations. Moreover, this value also follows from experimental facts unless it is supposed that the ω-curves, a considerable part of which are now known, show an anomalous behaviour beyond the observed part.

If it should prove true, as is made very probable by the above, that the dissociation energy of the neutral nitrogen molecule is about 9 volts, the interpretation of the afterglow by Sponer should of course be altered, perhaps in the way proposed in a recent letter to NATURE (June 9, p. 906) by J. Kaplan and G. Cario. In any case, nitrogen atoms play a predominating part in the production of the afterglow, as I have shown in a recent paper (*Zeits. f. Phys.*, **49**, 512; 1928).

GERHARD HERZBERG.

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The Raman Effect in Highly Viscous Liquids.

IN his address describing the fundamental discovery of a new type of secondary radiation (*Indian Journal of Physics*, Mar. 31, 1928), Prof. Raman emphasised that the change of wave-length in light-scattering is observed not only in the cases of vapours and liquids, but also in crystals and amorphous solids; a block of ice, for example, showing the shifted lines in the scattered spectrum in approximately the same positions as liquid water. Glasses, on the other hand, show broad bands and not sharp lines. With the view of elucidating the influence of the state of molecular aggregation on the Raman effect, I have made a series of observations of the scattering of the light of the mercury arc in pure dry glycerine at various temperatures, and in glycerine–water mixtures of various strengths.

The results are extremely interesting. The continuous spectrum which accompanies the sharp lines produced by scattering even in such mobile liquids as benzene (Raman, NATURE, April 21) is extremely prominent in glycerine. Fig. 1 shows the effect with the 4358·3 A. group as the exciting radiation, a number of more or less diffuse lines or bands being seen overlaid by a strong continuous spectrum. When the glycerine is heated to 120° C., the continuous spectrum becomes weak, while the new lines and bands remain practically unaffected, and the original mercury lines

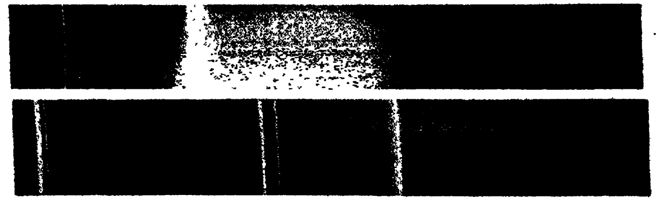

Fig I

Fig II

100%

80%

48%

actually brighten up. When pure glycerine is diluted with water, the intensity of the continuous spectrum also falls off rapidly. The spectrograms in Fig. 2 were obtained with 100, 80, and 48 per cent glycerine respectively, and show the progressive weakening in spite of the exposures having been increased with increasing dilution, so as to make the results comparable.

These results indicate that the transformation of the monochromatic incident radiation into general or white radiation is closely connected with the special state of molecular aggregation which gives rise to a high viscosity.

S. VENKATESWARAN.

Government Test House,
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Aug. 8.

Wave-length Shifts in Scattered Light.

IT seems still uncertain that the modified lines observed by Prof. C. V. Raman in the light scattered by liquids are of the incoherent type of radiation.

Raman has observed that when the ordinary scattering of carbon dioxide brightened up as a cloud was formed near the critical state, the modified scattering increased in intensity also. This appears to indicate coherence in the modified radiation.

I have recently photographed the spectrum of the light scattered by a mixture of phenol and water just above the critical solution temperature and illuminated by a glass mercury lamp. The ordinary scattering here is very intense, so that the mercury lines in the scattered spectrum are very black and very much widened out by over-exposure; yet no trace of the modified lines appears. With benzene, on the other hand, I have found the modified lines showing clearly on a plate much less exposed for the ordinary lines.

It seems, then, that in the case of the phenol–water mixture, the intensity of the modified scattering does not increase with that of the ordinary scattering as the critical state is approached. This would be true if the modified scattering were incoherent, as anticipated by the theory of Kramers and Heisenberg.

The failure of Lord Rayleigh and Cabannes to discover the modified lines in their careful study of gases seems to suggest that in the scattered spectra of gases the modified lines are relatively less bright

than in those of liquids. This also would be the case on the assumption of incoherence.

A further observation may be of interest. Raman remarks on the peculiar polarised 'fluorescence' of glycerine. Prof. J. C. McLennan has very kindly placed at my disposal a large Hilger spectrograph for the study of the light scattered by glycerine. The mercury lines comprising the ordinary scattering show very clearly in the region studied (from about 3200 A. to 5800 A. on a nine-inch plate), but no modified lines appear. Instead, there extends across the whole region photographed a single fluorescent band which is quite continuous even at the considerable dispersion afforded by this instrument. This 'fluorescent' band is partially polarised.

Raman has found similar though much narrower bands in the scattered spectrum of water and of methyl alcohol. The presence of such a very wide band in the spectrum of glycerine lends support to the inference that the broadening out of the modified lines to bands is associated with the presence of the (OH) group in the formula.

W. H. MARTIN.

Chemical Laboratory,
University of Toronto,
Aug 20.

Range of Audibility of Gunfire.

AT a time when considerable attention is being given to 'abnormal' propagation of sound, cases of exceptionally long range 'normal' propagation may be of interest.

On July 4, at about 1.23 P.M., a sound like distant gunfire, accompanied by a feeble rattle of windows, was heard at my house in Hythe, and I found on telephoning Dr. Tucker (who is warned by Dr. Whipple about firing practice at the Isle of Grain) that he had received a telegram announcing firing at this time. On tuning in my wireless set to 5XX, the signals broadcast by the B.B.C. giving the instant of firing were picked up, and the intervals between firing and the arrival of the sound were timed by my watch for eight rounds. The wireless signals ceased at about 2.0 P.M. but the gun was heard for at least half an hour longer, at roughly four-minute intervals.

The time of travel of the sound was 2 min. 33 sec. for two rounds, which were both described at the time as heard very feebly but distinctly indoors; 2 min. 34 sec. for five rounds, which were variously described as 'scarcely audible' to 'quite loud, shaking window,' and 2 min. 35 sec. for one round which was heard loudly.

The distance from my position to the gun was 168,750 feet, and the average time of travel was 2 min. 33·9 sec., giving a velocity of 1096 feet per second. The bearing of my position from the gun was 148° to the nearest degree.

The gun was again heard by several observers near Lympne and at Newchurch several miles farther west, on Aug. 2. At Lympne it was only heard with close attention in a sheltered position outdoors, but at Newchurch it was heard more plainly. The distances from the gun were 166,600 feet and 163,150 feet respectively. Timing was done at Lympne by chronometers ticking half seconds and at Newchurch by ⅕th second stop watches. The average time for six rounds at Newchurch was 147·3 sec., giving a velocity of 1107·7 feet per second. The average time for four rounds at Lympne was 150·4 sec., giving a velocity of 1107·6 feet per second. The bearing of Lympne from the gun was 150° and the bearing of Newchurch was 160° to the nearest degree.

From a casual inspection of meteorological data for these days, it would appear that the path of the sound was much more direct on Aug. 2 than on July 4.

P. ROTHWELL.

Air Defence Experimental Establishment,
Biggin Hill Aerodrome,
Westerham, Kent, Sept. 6.

Photographic Enlargement of Small Solid Objects.

IN NATURE of Aug. 18, p. 239, Mr. A. Mallock makes the admirable suggestion that the required magnification should be obtained, not directly, but by ordinary enlargement from a negative showing the object on some lower scale—the intermediate negative being of course taken to such a standard of sharpness as will permit of the subsequent enlargement. This seems to be the only way by which the great difficulties of this kind of work can be overcome. The most troublesome business of all is that of focusing, and this could be entirely eliminated if a simple form of enlarging camera were carefully and permanently registered to give perfect focus on some one fixed intermediate scale, and means were provided for measuring exactly the depth of the object about to be photographed, and for putting the object in its proper position in front of the lens.

In the *British Journal of Photography* of Oct. 30 and Nov. 6 and 13, 1925, under the heading "Low Magnification Photography," I endeavoured to write something useful on this subject, and I was thrown back on the method now suggested as the only practicable one. For higher magnifications, the apparatus was registered to give a direct three diameter negative, while for magnifications from one to three diameters, it was registered to give natural size. A very sensitive 'focus register' was described which served the double purpose of measuring the photographic depth of the object and placing it in position.

It is a pity that Mr. Mallock has deserted the usual method of defining the sharpness of a photograph by the diameter of the blurs or confusion circles on the negative which represent points on the object, as nothing seems to be gained by the change and his argument is not easy to follow. The example he has chosen—a twenty diameter enlargement of a tenth of an inch depth of object—is also very extreme and scarcely practicable, at least with a 0·1 inch stop. The resulting blurs in this case, as shown by his very useful formulæ, would be 0·02 inches in diameter, or twice that allowed by the lowest accepted standard of sharpness.

The extent to which magnification can be carried out will depend upon the smallness of the stops that can be used without introducing diffraction and other troubles. For this and other technical reasons I was compelled to draw the line at a maximum of magnification of ten diameters. But between one and ten diameters or less, an immense variety of useful and interesting work for the photographic illustration of books lies waiting to be done.

H. C. BROWNE.

Dublin, Sept. 6.

Can the Hand be thrust in Molten Lead without Injury?

In reply to Mr. A. S. E. Ackermann's inquiry in NATURE, Sept. 8, p. 349: Some thirty years ago I gave a popular lecture on "Flat Irons and the Spheroidal State" at Birkbeck College, at the end of which I illustrated the ancient ordeal of fire by plunging my hand—up to the wrist—into about 80 lb. of molten lead. The lead must be hot—that is the secret.

[illegible]

23 Carson Road,
Dulwich, S.E.21.

The Influence of Engineering on Civilisation.[1]

By Sir William Ellis, G.B.E.

Engineering in its many branches has taken, and is still taking, a very extensive part in connexion with the amenities which are associated so closely with our domestic life, and indeed our happiness. Each branch of engineering has added its quota to the comfort of our lives, and I think it may be claimed that no other profession has so direct an association with our modern civilisation. The enormous increase in population during the nineteenth century, coupled with the segregation of that population in industrial centres, arising out of the extraordinarily rapid development of industry in Great Britain and other countries during that period, has introduced new problems in connexion with health and transport, and it has been the task of engineering in its many branches to deal with these problems.

The introduction of railways and of steamers during the first half of that century led the way to an enormously increased demand for coal, iron, and steel, and as the inventions of Sir Henry Bessemer and Sir William Siemens for making steel were developed, the necessity was evident to engineers and chemists for training schools to deal with the physical and technical problems involved in engineering and metallurgy, so as to arrive at a far greater accuracy, both in design and construction, than had hitherto been considered necessary or possible.

We have to admit, however, that the progress of industry depends very largely on the enterprise of deep-thinking men who are ahead of the times in their ideas. I may quote Dr. Clifton Sorby as such an instance. He introduced by his researches the microscopy of steel, and yet it was many years before this became a recognised method of gauging the quality of all classes of steel. Another great inventor, whom we all respect and are delighted to have still in active work, is Sir Charles Parsons, and I look back many years to the early 'eighties when Sir Charles put in years of research work in connexion with high speed engines before he successfully produced the steam turbine. Since that time he has devoted a large portion of his life to developing improvements both in the design of the turbine and the machinery for producing it, which have ultimately brought about its world renown.

Civil Engineering.

The point which appears to me to stand out prominently in this branch of the profession is the fact that the structures to be dealt with are in many cases of an enormously costly nature, and have to be carried out with such careful study and comprehension of the varying problems to be dealt with so as to ensure permanent efficiency and safety in the future.

The great reservoirs and harbours of the world may be regarded as the cathedrals of engineering. The varying natural problems to be dealt with involve a very high level of technical education. In the construction of reservoirs, docks, and harbours, a considerable knowledge of geology is essential, and in harbour construction the varying effects of tides, which have to be studied minutely, have an important influence on the work to be undertaken. Throughout the world will be found monuments to the skill of the civil engineer, and the very existence of the population in our large cities in health and comfort is the result of his work, for without an ample and reliable supply of water of good quality, both for personal and industrial use, and an efficient drainage control, our death-rate would indeed be very different from what it is. If we turn for a moment either to India, with its great barrage enterprise, or Egypt, with the noble Assuan and Sennaar dams, truly outstanding works of the civil engineer, we find the prosperity of these countries largely resulting from the magnificent irrigation works which have been carried out there. Special development of produce growing in many countries is only being limited by the fact that insufficient irrigation works have so far been carried out. New Mexico and Arizona are two great provinces with potentially fertile land available for agricultural development, but they are so short of water that irrigation is an absolute necessity.

The large increase in tonnage of ocean-going vessels has resulted in the necessity for larger docks and harbour basins, and the development of railways all over the world, many of them in difficult mountainous countries, has given the civil engineer a great opportunity in designing bridges for carrying this heavy traffic. Many will appreciate the magnitude of the new bridge over Sydney Harbour which is now being constructed by British engineers, and the Forth Bridge still holds its own as a masterpiece of British engineering skill and the construction was in the hands of a Scotch firm well known in Glasgow. The new high-level bridge at Newcastle and the new Mersey tunnel are, I suppose, the most interesting civil engineering works at present in progress of construction in Great Britain, in addition to the considerable dock extensions now proceeding at Southampton, whilst in Canada a very noble bridge is now being thrown across the St. Lawrence River at Montreal.

Transport.

It may truthfully be said that the development of the potential wealth of any country depends mainly on the means of transport, both personal and industrial. I would allude especially to the great corn-growing countries where the home consumption bears only a small relation to the possible production. The knowledge that there is efficient transport both by rail and for export by sea is the greatest incentive to the farmers to spend money in extensive cultivation with the certainty of a ready market for such production.

[1] From the presidential address to Section G (Engineering) of the British Association, delivered at Glasgow on Sept. 7.

The comparison of travel to-day, both by land and sea, with my early journeys in Europe nearly fifty years ago, emphasises in my mind how much we are indebted to the engineer, in the way of personal safety and comfort and also prompt delivery of our products. A journey in the Balkans in the winter of 1881, when sleeping cars and restaurant cars were almost unknown, and when the largest vessel sailing from Mediterranean ports was in the neighbourhood of 4000 tons, compares very unfavourably in speed and personal comfort with the facilities which are available to-day. The comfort and safety of modern travel is to my mind one of the glories of modern civilisation. The 40,000 to 50,000 tons Atlantic liner, embracing as it does almost every class of engineering skill, is not only an example of artistic beauty, but is also one of the finest example of human power combating the forces of Nature. To be on one of these vessels driving into a gale at twenty knots is an experience never to be forgotten, and we are glad to realise what a large share the shipbuilding firms of Glasgow have had in the development of these large Atlantic liners.

Railway transport has also made great progress in all measures affecting personal safety and the efficient carrying of our various products. The railway engineers have every reason to be proud of their management of the complex organisation represented by the great railway systems all over the world. We are personally much safer travelling in an express train than we are crossing the streets of a great city, and I think we may justly be satisfied by the fact that in no country do the railways afford more comfortable or more rapid travelling facilities than in our own.

Naval Architecture.

This comprises shipbuilding and marine engineering and represents a very important part of my subject, dealing, as it does, with the transport by sea and lakes of food and materials, and with the comfort and safety of the many thousands of passengers travelling to and from Great Britain. The wooden vessel in the early part of last century held its own very stubbornly against the introduction of iron or steel vessels, and the mechanically propelled vessel had to fight very hard to oust the very efficient sailing vessels which were then carrying the trade of the world. I imagine that some with artistic tastes will not be willing to admit that the beauty of the present type of machanically propelled vessel is comparable with the picturesque five- and six-mast sailing vessels which we used to see in our earlier days.

Great Britain has undoubtedly been the pioneer in the building of large warships and passenger liners, also in the development of the very large horse-power therefor. The considerable increase in the tonnage of ships brought with it the necessity for a corresponding increase in the mechanical appliances in connexion with their construction. The trial runs carried out before a new ship is taken over by her owners are a severe test of the excellence of workmanship. They are a necessary test to ensure that long voyages of five to six weeks with machinery running continuously at nearly full power can be undertaken without fear of trouble arising from heated bearings or other causes. A new ship may be exposed to such rough weather on her first voyage that, unless her plating and riveting are carried out in a first-rate manner, she may arrive in her first port in a damaged condition. Glasgow has taken a leading part providing men who, in all weathers and under conditions rendered difficult by the magnitude of modern vessels, maintain the high level of efficiency which is represented in the manufacture of these large hulls. The vessels of the greatest tonnage built on the Clyde have been the *Aquitania* (46,000 tons) and the *Lusitania* (32,500 tons). Other large vessels built in the British Isles have been the *Olympic* (46,439 tons) and the *Mauretania* (30,696 tons). Since the War there has been a lull in the building of liners of large tonnage and horse-power, caused, no doubt, by financial considerations.

Shipbuilding is especially interesting inasmuch as it combines in one structure the varied efforts of almost every class of artisan dealing with both iron and steel and cabinet making and woodworking generally, in addition, of course, to the large and varied amount of mechanical engineering. High and low pressure triple expansion engines held their own for a considerable period, and it was, I suppose, the interesting trials of the *Turbinia* which brought about the first change from this method. It is an interesting fact that our fellow-member, Sir Charles Parsons, to whom I have already alluded, should live to see such successful development of his patent, and a recent paper read by him and his co-workers describes in a very interesting manner the gradual developments and changes in design in turbines up to the present time. Such developments range from the *Turbinia*, which had a displacement of 44½ tons with 2100 h.p., to the battle cruiser *Hood* of 41,200 tons and more than 150,000 h.p.

The introduction of geared turbines, so as to arrive at relatively efficient speed as between engine revolutions and propeller revolutions, has brought about valuable economies and helped the turbine principle to maintain its reputation. The development of internal combustion engines for marine purposes has made great strides in recent years. Various types of these engines are already in active service, and a horse-power of 36,000 on four propellers has already been achieved with efficiency; probably the limit has not yet been reached. The use of oil instead of coal on board ship, especially for passenger purposes, represents many advantages, and anyone who has visited the stokehold of a large passenger liner with the hundreds of men stoking with coal must realise the immense advantage, both physical and otherwise, which results from oil burning directly on the boilers. All inconvenience caused by dust in re-coaling is avoided, and the boiler tenting is carried out by

young mechanical engineers, doing away with all the labour required by coal burning. In a vessel of large tonnage the saving in wages and maintenance of several hundreds of stokers represents an enormous economy in many directions. The question of larger horse-power and/or electrically driven ships is one of the problems to which marine engineers are at present turning their minds.

A new development which is now being introduced is the use of considerably higher steam pressures in boilers. The first application of this was the *King George V.*, a boat built recently on the Clyde, and our section has been favoured with a paper from Mr. Harold Yarrow dealing with some of the problems which have arisen in introducing high pressures. As will have been gathered from his paper, these problems are not solely those of the engineer who has to build the boilers. They are also closely associated with steel and metallurgical questions incident to the special manufacture of parts of the boilers owing to the much greater strength required.

MECHANICAL ENGINEERING.

It is difficult to regard mechanical engineering literally as a separate branch of engineering, for although numerically, I suppose, the mechanical engineers exceed the numbers of any other branch, nearly all their duties are associated with other types of engineering.

In connexion with civil engineering, all the plant occupied in harbour, dock, and railway construction is in the hands of the mechanical engineer. Also in transport and marine engineering the mechanical engineer is largely engaged in the engine building of both locomotives and marine engines and other types of auxiliary machinery for these purposes.

In electrical engineering, although this branch no doubt includes engineers without mechanical training, I would venture to say that the engineer is in an infinitely stronger position if he has received some training first as a mechanical engineer and specialised in electrical engineering afterwards.

A further important branch of the mechanical engineer's work is represented by the maintenance of machinery in the large steel works throughout the country and in the mills and factories of all descriptions. The directors of these companies are largely dependent on the advice of the engineer-in-charge in giving consideration to developments and the introduction of new types of plant to maintain production on an economic basis.

In mechanical engineering I must include the very important subject of machine-tool construction, a branch of engineering which has made very great strides and introduced many changes of design to meet new requirements in the last thirty years. Mass production on an economical basis in many industries has been the direct result of various tool-makers being able to produce special tools confined to the production of thousands of identical articles of a complicated design. I refer to articles produced at a cost of one-tenth to one-twentieth of what would be possible without machine tools specially designed for the purpose.

The introduction of high speed tool steel enabling far heavier cuts to be taken both by lathes and planing machines has rendered obsolete a large quantity of machine tools throughout the country, and the introduction of the electric drive has also brought about great changes in the design of machine tools. We hear to-day of some works in other countries without a single machine tool at work of pre-War date, a most desirable state of things, but one which, unhappily, the economic circumstances in Great Britain have rendered impossible up to the present time.

May I make a suggestion to the tool-makers in Great Britain? When we are putting down an important new machine tool I find the makers will give every possible help in meeting our requirements in design and output, but they rarely follow up and ascertain what the real performance of the tool has been. To many of them 'no news is good news.' I think this is a mistake on their part. How many improvements and modifications, probably saving their clients money, could be made if they would periodically send the designer or chief draughtsman round to the works where these machines are actually at work and ascertain at first hand from the foreman and even the workman what criticisms they have to make, and accept for careful consideration any suggestions that may be put forward based on personal knowledge of the output of the machine.

MINING ENGINEERING.

In dealing with this section I propose to confine myself to coal mining, so as to shorten what I have to say, and also to be able to apply myself more closely to the development of coal mining as affecting civilisation.

Prior to the introduction of modern means of transport and the development of the iron and steel trade, the production of coal in Great Britain, both in the aggregate and per colliery, was very small, and consequently the amount of virgin coal face exposed at any one time in a colliery was quite moderate. Therefore the effusion of gas was not sufficiently large as to introduce a serious danger to men working with naked lights. Ventilation was carried out by means of a furnace in the bottom of the upcast shaft, the draught being sufficient for ventilating the moderate area of the workings. Increased production necessitated the adoption of mechanical means of ventilation and large fans were installed. Science had a large share in making colliery development on a big scale possible by the introduction of the Humphry Davy and other safety lamps. These warned the miners of the presence of gas and consequent danger. The much heavier tonnage produced in a given time necessitated the introduction of large horse-power winding engines, and also of wire ropes which would be sufficiently pliable to pass over the pulleys and headgear, and also be strong

enough to carry not only their own weight, which in a shaft of 500 yards is not inconsiderable, but, in addition, a loaded cage involving a weight of thirty tons or more.

A sufficient supply of coal at a moderate price is a matter of interest to every inhabitant and manufacturer in the country, and therefore any engineering devices which have been introduced to ensure comfort and safety of the miners, and at the same time to give us our coal supply for manufacturing and domestic purposes at a moderate price, are of interest to everyone. Although we unhappily know that colliery explosions occasionally occur with very dire results, and regret the many accidents to miners arising out of falls of roofs, etc., those of us who are conversant with coal mining matters realise how much science and engineering have done to lessen the risk under which the miners work. Underground haulage has been everywhere adopted, so that the use of men for this arduous work, and, to a great extent, ponies also, has been abandoned. This underground haulage is largely carried out by compressed air engines placed underground, as in many pits it has not been felt safe to introduce electric power for the purpose except in the immediate neighbourhood of the shafts. It is true that the electrical engineer has gone a long way in lessening the liability to sparking, and in enclosing the motors so as further to lessen this risk. We are still left, however, with possible danger caused by the cables along the main roads, which, however carefully placed, are still liable to be damaged by unexpected falls of roof, thereby introducing a potential danger which is difficult to eliminate.

ELECTRICAL ENGINEERING.

This branch of engineering covers a very wide range of subjects and affects our social life almost more intimately than any other type of engineering, except perhaps the supply of good water and efficient drainage installations. Telegraphy, telephony, wireless, electric lighting, electric heating, electric driving, and electric power in their various ranges all enter into and affect the comfort of our domestic life. In considering this branch of engineering as a whole, I find it very difficult fairly to divide the credit for its development between the pure scientist and the electrical engineer. It is interesting at this meeting in Glasgow to recall that it was at the British Association meeting in this city in 1876 that Graham Bell, in conjunction with Lord Kelvin, brought to the Association's notice the telephone, and, further, the fact that at the Plymouth meeting of this Association in 1877, I shared with many eminent members of the British Association the interesting privilege of telephoning from the saloon to the bridge on the excursion steamer, with Prof. Graham Bell on board, going to and from the Eddystone Lighthouse. I allude to this fact because in those days it was regarded as a wonderful scientific invention which fascinated the most eminent scientific men. Yet to-day we take it all for granted, and scarcely realise the comfort and convenience that the introduction of the telephone has brought into our lives.

I admit that the introduction of wireless telephony and telegraphy has amazed the world to a greater extent than that of the telephone, and it is certainly more within the capacity of the pure scientist than of the engineer to explain the scientific problems involved. It is impossible to say what number of lives have already been saved by boats in distress having been able to secure help from other vessels by means of wireless communication.

The development of electricity as a mechanical driving power was very slow up to a certain date. For example, I went by electric train from Berlin to Charlottenburg in the spring of 1882. The running of the railway appeared to be quite satisfactory, and yet it was at least ten, and I think fifteen, years before any real development took place in the way of electric railways or trams, the difficulty, I believe, being in producing satisfactory dynamos on an economic basis.

In Great Britain considerable developments are taking place on the various main lines, but engineers are at present concentrating on the use of electric driving mainly for suburban traffic, and not at present on main line long distance expresses. It is probable that the great extension of high power installations throughout the country contemplated by the Electricity Commissioners will render possible a more extensive use of electric trains on our main lines.

The application of electricity for driving purposes in the various large works in Great Britain made very rapid strides as soon as electrical machinery for the purpose was available. Apart from the economy represented by its introduction, the change enabled the management to register the amount of power used by each type of machine under varying loads of service, a circumstance which was impossible with belt-driven machines, when the power varied according to the tightness and width of the belt.

The public, I think, fails to realise that electric lighting for domestic purposes, if charged at a reasonable rate, does not represent any real charge on the household. It is so clean in its application that, in my opinion, the necessity for cleaning and decorating which is avoided in many cases represents a greater saving than the amount paid for electric light. In addition we have the great advantage that it does not burn oxygen, and therefore we have more healthy conditions in our rooms compared with any other method of lighting.

Since I roughed out this address it has been my privilege to make a journey across America from New York to the Pacific Coast, and return through the Rocky Mountains and Canada, and throughout my journey I could not help realising how large a share engineering in its broadest sense has taken in developing these wide regions. Those of us who are spending our lives in engineering work may justly be proud of the large share the members of our profession are taking in promoting and advancing the civilisation of the world.

The Mystery of Life.[1]

By Prof. F. G. Donnan, C.B.E., F.R.S.

During the last forty years the sciences of physics and chemistry have made tremendous strides. The physico-chemical world has been analysed into three components, electrons, protons, and the electro-magnetic field with its streams of radiant energy. Concurrently with these advances astronomy has progressed to an extent undreamed of forty years ago. Amidst the vast cosmos disclosed to the mind of man, our sun winds its modest way, an unimportant star, old in years and approaching death. Once upon a time, so the astronomers tell us, its surface was rippled by the gravitational pull of a passing star, and the ripples becoming waves broke and splashed off. Some drops of this glowing spray, held by the sun's attraction in revolving orbits, cooled down and became the planets of our solar system. Our own planet, the earth, gradually acquired a solid crust. Then the water vapour in its atmosphere began to condense, and produced oceans, lakes, and rivers, as the temperature sank. It is probably at least a thousand million years since the earth acquired a solid crust of rock. During that period living beings, plants and animals, have appeared, and, as the story of the rocks tells us, have developed by degrees from small and lowly ancestors. The last product of this development is the mind of man. What a strange story! On the cool surface of this little planet, warmed by the rays of a declining star, stands the small company of life. One with the green meadows and the flowers, the birds, and the fishes, and the beasts, man with all his kith and kin counts for but an infinitesimal fraction of the surface of the earth, and yet it is the mind of man that has penetrated the cosmos and discovered the distant stars and nebulæ. Truly we may say that life is the great mystery, and the study of life the greatest study of all. The understanding of the phenomena of life will surely be the crowning glory of science, towards which all our present chemical and physical knowledge forms but the preliminary steps.

Observing the apparent freedom, spontaneity, and indeed waywardness of many forms of life, we are at first lost in amazement. Is this thing we call life some strange and magical intruder, some source of lawless and spontaneous action, some fallen angel from an unknown and inconceivable universe? That is indeed the question we have to examine, and we may begin our examination in a general way by inquiring whether living things are subject to the laws of energy that control the mass phenomena of the inanimate world. The first of these laws, known as the law of the conservation of energy, says that work or energy can only be produced at the expense of some other form, and that there are definite rates of equivalence or exchange between the appearing and disappearing forms of energy. In a closed system we can make up a balance sheet and we find that the algebraic sum of the increases and decreases, allowing of course for the fixed rates of exchange, is zero. That was one of the great discoveries of the nineteenth century. The physiologists have found that living beings form no exception to this law. If we put a guinea-pig or a man into a nutrition calorimeter, measure the work and heat produced and the energy values of the food taken in and the materials given out, we find our balance sheet correct. The living being neither destroys nor creates energy.

Another great discovery of the nineteenth century, the so-called second law of thermodynamics, restricts the direction of energy transformations. So far as is known, the facts of biology and physiology seem to show that living beings, just like inanimate things, conform to the second law. They do not live and act in an environment which is in perfect physical and chemical equilibrium. It is the non-equilibrium, the free or available energy of the environment, which is the sole source of their life and activity. As Bayliss so finely put it, equilibrium is death.

The chief source of life and activity on this planet arises from the fact that the cool surface of the earth is constantly bathed in a flood of high temperature light. If radiation in thermal equilibrium with the average temperature of the earth's crust were the only radiant energy present, practically all life as we know it would cease, for then the chlorophyll of the green plants would cease to assimilate carbonic acid and convert it into sugar and starch. The photo-chemical assimilation of the green plant is a fact of supreme importance in the economy of life. This transformation of carbonic acid and water into starch and oxygen represents an increase of free energy, since the starch and oxygen tend naturally to react together and give carbonic acid and water. A living being is not a magical source of free energy or spontaneous action. Its life and activity are ruled and controlled by the amount and nature of the free energy, the physical or chemical non-equilibrium, in its immediate environment, and it lives and acts by virtue of this. The cells of a human brain continue to act because the blood stream brings to them chemical free energy in the form of sugar and oxygen. Stop the stream for a second and consciousness vanishes. Without that sugar and oxygen there could be no thought, no sweet sonnets of a Shakespeare, no joy, and no sorrow.

To say, however, that the tide of life ebbs and flows within the limits fixed by the laws of energy, and that living beings are in this respect no higher and no lower than the dead things around us, is not to resolve the mystery. Growth and development seem to proceed on a definite plan, and apparently purposeful adaptation confronts us at many stages of life. How can the differential equations of physics or the laws of physical

[1] From an Evening Discourse delivered on Sept. 11 at the Glasgow meeting of the British Association.

chemistry attempt to explain or describe such strange and apparently marvellous phenomena? The answer to this question was given more than fifty years ago by the great French physiologist, Claude Bernard. We must patiently proceed, he said, by the method of general physiology. Its method consists in determining *the elementary condition of the phenomena of life*. We must decompose or analyse the great mass phenomena of life into their elementary unit or constituent phenomena.

To-day general physiology in its application of physics, chemistry, and physical chemistry to the operations of the living cell, is the fundamental science of life. Patiently pursued and step by step it is unravelling the mystery. The future findings of general physiology may be as strange to the investigators of to-day as the relativity theory of Einstein and Minkowsky was to the physicists of a few years ago; yet they will be continuous and homologous with the science of to-day. Should, indeed, a new form of energy, 'a special nervous energy,' be discovered, as predicted by the eminent Italian philosopher, Eugenio Rignano, it will be no twilight will-o'-the-wisp, no elusive entelechy or shadowy vital impulse, but an addition to our knowledge of a character permitting of exact measurement and of exact expression by means of mathematical equations.

The chemistry and energy changes of muscle have been discovered recently by Meyerhof in Germany and by A. V. Hill and others in England. When the muscle tissue contracts and does work, it derives the necessary free energy, not from oxidation, which is not quick enough, but from the rapid exothermic conversion of the carbohydrate glycogen into lactic acid. When the fatigued muscle recovers, it recharges its store of free energy; that is to say, by oxidising or burning some of the carbohydrate, it reconverts the lactic acid into glycogen. Thus in the recovery stage we have the coupled reactions of exothermic oxidation and endothermic conversion of lactic acid into glycogen. Everything proceeds according to the laws of physics and chemistry. Here we see one of the elementary phenomena of life already to a great extent analysed and elucidated.

Another example is what I may call the blood equilibrium. The red blood cells are enclosed in a membrane which does not allow the hæmoglobin to escape, and only permits of the passage of inorganic anions, though water and oxygen can pass freely in and out. Between the red cells and the external blood plasma in which they are submerged there exists a whole series of delicate exchange equilibria, such as water or osmotic equilibrium, ion-distribution equilibria, etc. The entrance of oxygen, which combines with the hæmoglobin, converts it into a stronger acid and ejects carbonic acid from the bicarbonate ions within the cell. Any disturbance of one of these equilibria produces compensating changes in the others. The whole series of equilibria can be written down in a set of precise mathematical equations. Thus two of the most important elementary phenomena of many forms of life, namely, respiration and the exchanges of the red blood cells, have been analysed, subjected to exact measurement, and described by exact mathematical equations.

What is the lesson to be drawn from these examples? No less than that the elementary phenomena of life are *deterministic*; that is to say, that events compensate or succeed each other just as in the physico-chemical world of inanimate things, and that their compensations and successions can be exactly measured and expressed in the form of precise mathematical equations. The investigations of general physiology, so far pursued, indicate that the elementary phenomena of life are quite as fully deterministic as phenomena on a corresponding scale of magnitude in the inanimate physico-chemical world.

Let us now make the daring supposition that general physiology, following the lead of Claude Bernard, has eventually succeeded in quantitatively analysing every side and every aspect of the elementary condition of life. Would such a supposedly complete and quantitative analysis give us a synthesis of life? That is one of the most fundamental and difficult questions of biological science. A living being is a dynamically organised individual, all the parts of which work harmoniously together for the well-being of the whole organism. The whole appears to us as something essentially greater than the sum total of its parts. This aspect of the living individual was fully recognised by Claude Bernard. It has been emphasised recently by General Smuts in his remarkable book on "Holism and Evolution." Life, as seen by General Smuts, is constantly engaged in developing wholes, that is to say, organised individualities. We may indeed learn how the regulative and integrating action of the nervous system, so beautifully and thoroughly investigated by that great physiologist, Sir Charles Sherrington, serves to organise and unite together in a harmonious whole the varied activities of a complex multicellular animal. We may learn, too, how those chemical substances, the hormones, discovered by Bayliss and Starling, are secreted by the ductless glands, and, circulating in the *milieu intérieur* of an animal, act as powerful means for harmoniously regulating and controlling the growth and other activities of the various organs and tissues. Nevertheless, in spite of these great discoveries, the harmonious and dynamic correlation of the various organs and tissues of a living organism ever confronts us as one of the great mysteries of life. In an inanimate physico-chemical system we think, if we know the situations, modes of action and inter-relations of the component parts, whether particles or waves (or both), together with the boundary conditions of the system, that we have effected a complete synthesis of the whole. Though very crudely expressed, some such view as that lies at the basis of the Newtonian philosophy which rules our thought in the inanimate physico-chemical world.

Leibnitz once remarked that "the machines of nature, that is to say, living bodies, are still

machines in their smallest parts *ad infinitum*." Anatomy and histology have progressively disclosed the structure of living things. Histology has revealed to us the cell with its nucleus and cytoplasm as the apparently fundamental unit of all organs and tissues of a living being. What is contained within the membrane of a living cell? Here we approach the inner citadel of the mystery of life. If we can analyse and understand this, the first great problem—perhaps the only real problem — of general physiology will have been solved. The study of the nature and behaviour of the living cell and of unicellular organisms is the true task of biology to-day.

The living cell contains a system known as protoplasm, though as yet no one can define what protoplasm is. One of the fundamental components of this system is the class of chemical substance known as protein, and each type of cell in each species of organism contains one or more proteins which are peculiar to it. Strange to say, the living cell contains within itself the seeds of death, namely, those so-called autolytic enzymes which are capable of hydrolysing and breaking down the protein components of the protoplasm. So long, however, as the cell continues to live, these autolytic enzymes do not act. What a strange thing! The harpies of death sleep in every unit of our living bodies, but as long as life is there their wings are bound and their devouring mouths are closed.

It appears from A. V. Hill's work on non-medullated nerve cells and on muscle that the organised structure of these cells is a *chemo-dynamic* structure which requires oxygen, and therefore oxidation, to preserve it. The organisation, the molecular structure, is always tending to run down, to approach biochemical chaos and disorganisation. It requires constant oxidation to preserve the peculiar organisation or organised molecular structure of a living cell. The life machine is therefore totally unlike our ordinary mechanical machines. Its structure and organisation are not static. They are in reality dynamic equilibria, which depend on oxidation for their very existence. The living cell is like a battery which is constantly running down and requires constant oxidation to keep it charged.

The last great problem which I shall venture to consider in this brief sketch concerns the origin of life. If the living has arisen on this planet from what we regard as the non-living, then various extremely interesting points arise. It is already fairly certain that it originated, if at all, in the primeval ocean, since the inorganic salts present in the circulating fluids of animals correspond in nature and relative amounts to what we have good reason to believe was the composition of the ocean some hundred million years ago. The image of Aphrodite rising from the sea is therefore not without scientific justification. The question arises as to how organic substances could have arisen by degrees in a primeval ocean originally containing only inorganic constituents? The late Prof. Benjamin Moore took up this subject and endeavoured to prove that colloidal iron oxide, in the presence of light, moisture, and carbon dioxide could produce formaldehyde, a substance from which sugar can be derived. This work of Moore's has been actively taken up and developed by Prof. Baly in recent years. He has conclusively proved that, in the presence of light, moisture, and carbon dioxide, formaldehyde and sugar can be produced at the surface of certain coloured inorganic compounds, such as nickel carbonate. We may therefore conclude that the production of the necessary organic substances in the primeval ocean offers no insuperable obstacle to science.

The sincere and honest men who are advancing science, whether in the region of life or death, are those who measure accurately, reason logically, and express the results of their measurements in precise mathematical form. A hundred or a thousand years from now mathematics may have developed far beyond the extremest point of our present-day concepts. The technique of experimental science at that future date may be something undreamed of at the present time. But the advance will be continuous, conformal, and homologous with the thought and reasoning of to-day. The mystery of life will still remain. The facts and theories of science are more mysterious at the present time than they were in the days of Aristotle. Science, truly understood, is not the death, but the birth, of mystery, awe, and reverence.

Obituary.

ROALD AMUNDSEN.

HAD Ibsen lived to write the Saga of Roald Amundsen, he might have analysed the emotions which surged through the explorer's soul in a tempest of ambition, triumph, and tragedy. The dramatic episodes of the adventurous life seem to demand a psychological nexus more likely to be found in philosophy than in science, and only capable of full expression in poetry.

Roald Amundsen was born at Borgo in the south of Norway on July 16, 1872; he lived in Oslo from his infancy, going through the ordinary Norwegian educational course. His father, who was a shipowner, died when the boy was fourteen years of age, and his mother, being desirous of seeing him in the medical profession, induced him reluctantly to begin the preliminary studies at the University of Oslo. Since as a boy of fifteen he had been enthralled by the story of Sir John Franklin, he had secretly set his heart on becoming a polar explorer, and to fit himself for the life he took every opportunity of exercising himself in ski-running, and slept with open windows throughout the Norwegian winters. His first journey in Arctic conditions very nearly proved his last adventure in exploration. In the Christmas holidays of 1892 he started with a companion to cross the Norwegian plateau from a farmhouse near Oslo to one near Bergen, an uninhabited stretch of 72 miles, with no possibility of reaching Bergen if the house which marked the only practic-

able descent from the plateau were missed. It was missed, and after several days without any shelter but their sleeping bags their provisions failed, and when at last they struggled back to the eastward they had been four days without food. In none of his serious expeditions did Amundsen suffer more from cold and starvation.

On the death of his mother Amundsen dropped the hated medical classes and proceeded to qualify as a sailor, for he had decided that polar explorers who were not sailors were entirely at the mercy of the commanders of their ships. He served for several summers as a seaman on an Arctic ship and, studying in the intervals of the voyages, he speedily obtained his mate's certificate. When de Gerlache prepared his heroic adventure in the *Belgica* in 1897, Amundsen secured the position of first mate and rejoiced in the company of such nimble-witted and enthusiastic colleagues as Lecointe, Arctowski, and F. A. Cook. The *Belgica*, after wasting precious time in Tierra del Fuego, proceeded through the South Shetland Islands and along Graham Land until late in the season by a blunder, which Amundsen recognised but was not allowed to avoid; she was caught in the ice and drifted helplessly for more than a year, her company being the first of the human race to go through the long Antarctic night. Though equipped meagrely and at small cost, the *Belgica* was charged to the highest degree with scientific enthusiasm, and accumulated an almost incredible mass of scientific material and data. Amundsen learned eagerly what his scientific friends could teach him, and from his earlier experience he knew that fresh meat was necessary in order to escape scurvy, but he said that he could not convince his superior officers of this until after the terrible disease had got a firm hold on the ship's company. Then when the command devolved temporarily on the first mate, he insisted on the use of the seal and penguin meat he had stored up months before, and this had the happiest result.

On his return in 1899, Amundsen obtained his master's certificate and, equipped with the experience of ice-navigation, scientific observing, and polar hygiene, he prepared for an independent venture, resolving to be the first to traverse the North-West Passage and to study the locality of the north magnetic pole. He made the acquaintance of Nansen, who approved the scheme and gave him introductions. An attempt to get instruction in magnetic work at Kew met with a rebuff, but Dr. Georg von Neumayer welcomed the young Norwegian at the Deutsche Seewarte and secured for him further instruction at Potsdam. After mastering the technique of magnetic observations, Amundsen bought an old fishing smack 72 feet long, 11 feet wide, and 50 tons burden. He named her the *Gjoa*, fitted her with an auxiliary motor engine, then a novelty for a sea-going ship, and spent the summer of 1902 in oceanographical work off the Norwegian coast. He made the usual efforts to collect funds for his expedition from scientific societies, government grants, and private individuals, but when he had gathered a small band of kindred spirits and loaded his stores, there were still unsatisfied creditors who threatened to seize the ship. Amundsen resolved to elude these by a midnight start, and got away unobserved one day in June 1903. He crossed to Greenland and made his way in the track of Franklin. For two years he remained on the shore of Boothia Felix close to the magnetic pole, and secured a fine series of automatic magnetic records and a great collection of Eskimo handicraft from a tribe of 200 nomads who camped near him and knew nothing of white men except their grandfathers' stories of Franklin's time.

When free to move in August 1905, the *Gjoa* felt her way through the shallows of Simpson Strait, and after three weeks of acute nervous tension Amundsen's anxiety was changed to triumph by meeting an American whaler which had come through Bering Strait. The *Gjoa* had to spend another winter in the ice before she gained the Pacific, and, characteristically, Amundsen presented the little ship to the City of San Francisco as an historical memento, and she was placed on permanent exhibition in the Golden Gate Park. The expedition had been a splendid success, a worthy end to four hundred years of foiled endeavour.

Two strenuous years of lecturing in all the countries of Europe and in America brought Amundsen money enough to pay the debts of the *Gjoa* expedition. The next prize of exploration for which he lusted was the attainment of the north pole, and to secure this he resolved to emulate Nansen's drift in the *Fram*. He laid his plans, the Norwegian government gave him the famous old ship, and geographers of all nations smiled on the enterprise, preparations for which were nearing completion, when in the autumn of 1909 the news of Peary's success demagnetised the north pole of its stimulus to future exploration. Amundsen was grievously afflicted, but a new objective soon captured his heart. When Shackleton, fresh from his great Antarctic journey, lectured in Oslo later in the same year, Amundsen was a rapt listener. Lady Shackleton says that when her husband in a climax of eloquence quoted a verse of Robert Service about the call of the wild, a mystic light shone in Amundsen's eyes as if he had seen a vision, and she believes that at that moment he took his decision, but he kept it to himself.

In June 1910 the *Fram* was equipped and ready; her company, like all the world outside, thought she had started for Bering Strait and the Arctic Sea; but Amundsen sailed with the sealed orders of his great ambition locked in his heart. At Madeira for the first time he declared his intentions; his comrades gloried in the idea of a race with Scott to the south pole; the outside world was struck with amazement. Amundsen left a cable to be sent to Scott, who was already in New Zealand, but his mind was uneasy at the thought of the criticism his action would call forth. If both expeditions had been planned only for the advancement of science, there would have been no rivalry but only effective co-operation, and in fact the meteorological observations made by the Norwegians and discussed by Mohn proved of value in supplementing those of Scott's parties. Amundsen's was

confessedly a push to get first to the pole, and if he was given the desire of his heart, who can say whether leanness did not also enter into his soul ? His expedition was a model of foresight, equipment, and efficiency ; it went like clockwork, everything happened as planned, and on Dec. 14, 1911, Amundsen and his four comrades were the first men to reach the south pole. The return journey was as smooth and successful as that outward.

The achievement marked the zenith of a great man's power ; it was the finest polar journey in history. There followed the usual circle of lectures, feasts, and honours, but Amundsen had grown morbidly sensitive and searched every proffered tribute for a hidden slight. He felt bound to carry out his original project of drifting over the north polar area though the prospect seems to have lost its charm. Still, he proceeded with the equipment of an expedition on the *Fram*, which included an aeroplane, when the War broke out and he felt that he could not go.

By speculation in shipping Amundsen amassed a small fortune in the earlier years of the War, though a less mercenary man never lived. He put all his money, as he put all his strength, into the furtherance of his schemes of exploration. Now he proceeded at his own expense to build a polar ship, the *Maud*, and to bring together a new staff for investigating the Arctic Sea. In 1918 he was ready, and was informed that at his request a safe conduct from German submarines might be given, but his horror at German naval methods had led him a year before to return his German decorations to the Kaiser, and he refused to ask any favour now. The *Maud* skirted the coast of Norway and entered the Kara Sea, proceeding eastward beyond Cape Chelyuskin before being frozen in. In 1919 she was released in September and proceeded on her way ; but two of her crew had left the expedition and were lost for ever in Siberia.

Another winter had to be spent icebound on the Siberian coast, and in July 1920 the *Maud* had to proceed to Nome in Alaska, having accomplished the North-East Passage for the second time in history. Here four more of the party returned home, and the *Maud* at last set out for her drift with a complement of only four men, including Amundsen. Their attempt, hopeless from the first, led to nothing but misfortune. The ship had her propeller damaged, and after a third winter frozen off the coast of Siberia, she had to return under sail to Seattle for repair in 1922.

Amundsen returned to Norway, raised more funds, and became obsessed (the word is his own) by the idea that the future of polar exploration lay in the air. Returning to America he bought a Junker aeroplane and brought it to Alaska in the *Maud*, which proceeded under Capt. Wisting due north into the polar drift, while Amundsen, his aeroplane, and pilot were taken in a coasting schooner bound for Point Barrow, hoping to fly from there to Spitsbergen. They had to land, however, at Wainwright Inlet, where Amundsen left the machine and returned overland to Nome, making a journey of 800 miles over the snow on foot at the average rate of 50 miles a day. Such were his strength and fitness at fifty, yet he had been warned by a heart specialist nine months before that he must do no more exploring and avoid strenuous exertion. In summer he returned to the shore of the Arctic Sea, only to find his aeroplane damaged beyond repair. For the next two years his life was a nightmare of efforts, first to obtain new aircraft, then to right his utterly disordered finances. Friends turned against him, and it even seemed as if his career was ending in disaster.

At its lowest the tide turned with the advent of a wealthy and adventurous young American, Mr. Lincoln Ellsworth, who placed his resources and his cheering companionship at the disposal of the prematurely ageing explorer. Together they planned a flight in two flying boats from Spitsbergen to the north pole and back. The attempt was made in the early summer of 1925, and the boats had reached 88° N. when one had to descend from engine trouble and was found to be useless for further flight. The other joined it on a narrow lead of open water which rapidly froze, and for three weeks the six men toiled to level the rough ice and make a smooth runway along which the boat, fitted with ski for the purpose, could get up speed enough to rise. By something little short of a miracle this was achieved, and when the most hopeful had begun to fear the loss of the explorers, the little flying boat with twice its proper number of passengers dropped safely on the sea at Spitsbergen.

Before this narrow escape Amundsen had decided that the proper aircraft for polar flights was a lighter-than-air dirigible. Now Mr. Ellsworth purchased from the Italians a modified dirigible which was renamed the *Norge*, and in 1926 she flew safely to Spitsbergen. Here, while waiting for propitious weather for her flight to the north pole, Amundsen had to experience something of the emotion which he had caused in Scott at the south pole, for the American, Capt. Byrd, arrived at Spitsbergen with an aeroplane on which he flew to the pole and back before the *Norge* could make a start. Amundsen lost the first place in this polar race, but very speedily the *Norge* followed, reached and hovered over the pole, and then proceeded on her way across ice-laden seas previously unseen by human eye to Alaska, where the cruise ended successfully. Col. Nobile, who had designed and built the *Norge*, sailed in her as chief pilot, but the relations of the Norwegians and Italians became so strained that there was an open rupture on their return.

Amundsen's work was done. He achieved another climax of popularity, it is true, but his nerves were worn with years of strain and hardship, and the joy of his unequalled triumphs at both ends of the earth failed to outweigh the memories of the struggles, the disappointments, and the alienation of friends. He was prematurely aged, solitary, and despondent, when in the early summer of the present year Gen. Nobile set out in the *Italia* to outdo the exploits in the *Norge*. When the great airship met with disaster, the last dramatic scene

(*Continued on page 545.*)

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Reviews.

A Pioneer of Electrical Engineering.

Reminiscences. By R. E. Crompton. Pp. xv + 238 + 8 plates. (London: Constable and Co., Ltd., 1928.) 14*s.* net.

COL. CROMPTON is one of the few men now living who have clear recollections of the 1851 Exhibition in Hyde Park. When a child of six, accompanied by his mother, he came up to the Exhibition in a special train from Thirsk to King's Cross. The train was incredibly long, every seat was occupied, and it was drawn by six engines. Naturally, he was impressed by Paxton's wonderful crystal building shining and glistening in the sun, very different in appearance from the clumsy concrete buildings of the Wembley Exhibition. He dragged his mother to the machinery hall at one end of the Palace. Neither the Koh-i-noor diamond nor any of the numerous side-shows had any attraction for him comparable with the locomotives with their brilliantly polished piston rods and brasses burnished like gold. This had doubtless the effect of giving an engineering bent to his after life.

Crompton was born at Lion Hill, near Thirsk, in 1845. His father, who had been educated at Jesus College, Cambridge, did valuable diplomatic work, sometimes travelling on secret missions disguised as an Arab. His mother was the niece of Robert Burns's "Lass of Ballochmyle." She was very musical and was a friend of Mendelssohn. Colonel Crompton was their fifth and youngest child. He seems to have been a precocious boy. He remembers how in London in 1851 the steel-wheeled and horse-drawn vehicles rumbled over the granite-block paving with a deafening noise. Owing to this noise conversation was often impossible between him and his mother in busy thoroughfares.

Amongst Crompton's early schoolfellows was Dodgson the mathematician, better known as the author of "Alice in Wonderland." At the outbreak of the Crimean War his father, who was an officer in the militia, volunteered to take his battalion to the front. He was ordered to Gibraltar so as to relieve line regiments who were going to the Crimea. He took his family with him. During his stay his wife's cousin, who was the commander of H.M.S. *Dragon*, was allowed to take young Crompton on board his ship to the Crimea. Possibly his parents thought that naval discipline would be good for him. He started as his cousin's guest, but eventually it was found necessary to enrol him as a cadet in the Royal Navy. He thus commenced his service to Queen Victoria at the age of ten. When he arrived at the Crimea he went to visit his brother, who was in the trenches before Sebastopol. He thus gained, sixty years before the War, first hand knowledge of trench warfare. The shells were called 'Whistling Dicks,' and the flare-shells for lighting the no-man's-land 'Carcasses.' During the armistice after the great assault on the Redan, he found in front of the trenches countless lead bullets which appeared at first sight to be a bluish sort of gravel. Although he was only a child of eleven, yet as he had been in the firing line, he was awarded a medal and clasp.

On his return to England Crompton finished his education at Elstree and Harrow. Afterwards, when staying with his brother at Farnham, they rode over and saw the famous Sayers-Heenan prize-fight—a most unpleasant spectacle. During his holidays at Harrow he began to construct a full-sized road engine. At this time Messrs. Cook of York, and George Salt of Saltaire, were both building road engines, and he met and discussed with them various difficulties. This led to him fitting his engine with the differential gear now practically used in all road vehicles. The motive power for the machine lathe in his small workshop was a man who drove a large flywheel by hand.

In 1863, Crompton passed second in the examination for direct commissions in the army, and the following year was gazetted an ensign in the Rifle Brigade and sailed to India. The Suez Canal being still unfinished, he went overland from Alexandria to Suez. In India he finished his road engine, which made good progress on main roads. Hearing that R. W. Thomson of Edinburgh had got excellent results by using very large and thick rubber tyres

on tractor wheels, he got into communication with him and official tests were made of the Thomson engine. The results proved that mechanical haulage could advantageously be used to replace bullock haulage for Army and Post Office work. This marks an important epoch in the history of the development of automobiles. Before this, agricultural traction engines were the only ones allowed to be used in England, a man having to walk in front of them with a red flag to set the pace.

Crompton's Indian experiments were the first to show on an adequate scale what could be done with steam power on the road. The only available power at that time was steam. The internal combustion engine was not developed until about twenty years later. In 1875, Crompton returned to England and ended his personal connexion with the development of road transport in India. He found that mainly owing to the fear that the interests of horse haulage would be injuriously affected, there was little opening for an engineer for road haulage in England.

Having read of the developments of arc lighting in France by Gramme, Crompton entered into partnership with Mr. Fawkes to import electric lighting apparatus from France. Shortly afterwards he inaugurated the firm of Crompton and Company, electrical engineers, at Chelmsford. At the Paris Exhibition in 1881 they were awarded the first gold medal ever given for electric lighting plant. Early in 1882 his firm installed a complete electric lighting plant at the Mansion House. A 16-horse power Crossley gas engine in a basement room drove a dynamo by means of a belt. The lighting was a success, but one evening the belt came off the pulley and was flung alternately against the ceiling and floor of the dynamo room. People in the building were terrified by the banging noise, imagining that the Lord Mayor and his guests were being attacked by Fenians, of whose designs everyone was then talking.

The great fire which destroyed the Ring Theatre in Vienna in 1883 was indirectly the means of providing Crompton with the opportunity of experimenting on large scale electricity supply. The Emperor Francis Joseph was so impressed by the dangers of gas lighting that on the advice of the gas company he consulted Crompton. The result was a five-wire supply on the direct current system. In 1886 the Opera House was illuminated by electricity. The Crown Prince Rudolph was looked on by Crompton as one of his pupils, and it was through Crompton that he was first introduced to the Baroness Vetsera, who afterwards became his morganatic wife. The tragedy of 1889, when they were both found dead, he attributes to murder and not to suicide.

The German system of doing work on deferred payment terms with the help of their bankers, on what is known as the group bank system, prevented Crompton's from getting much continental business. In 1890, Crompton read an important paper to the Institution of Civil Engineers on the generation and distribution of electrical energy, pointing out for the first time the importance of the 'load factor' of a station. Between 1890 and 1899 he was busy on electrical work in all parts of the world.

In October 1899 the Boer War began, Crompton volunteering at the earliest possible moment. After many unpleasant experiences he organised a fleet of transport engines and waggons and did military work of great value.

In 1906, in conjunction with Le Maistre, Crompton drew up the constitution of the International Electrotechnical Commission which has done excellent work in standardising apparatus and in drawing engineers of all nationalities together in bonds of friendship. The first three presidents were Kelvin, Mascart, and Elihu Thomson, the last being the originator of the international scheme. The great success of this commission is largely due to Crompton, who was for so long its honorary secretary, and is now the honorary president.

In 1910, Crompton was elected engineer to the Road Board, on which he has done valuable work. In 1914 he offered his services to the War Office, to help in the mechanisation of the army, but his offer was rejected. In 1915, however, Mr. Churchill applied for his services. He did work of great value in connexion with the design of tanks of all kinds.

Twenty-eight years ago, Crompton was enthusiastic about the many boons that would ensue to Great Britain if a cheap electrical supply became universal. England would no longer be spoilt by densely populated industrial centres, and cottages would be evenly spread over the kingdom. The factory hands, instead of having to work under shafting in factories, would be able to carry on their industrial pursuits in their own cottage homes. This has been done in Switzerland, in Sweden, and in many other places abroad. Colonel Crompton is doing his utmost at present to enable his ideas to be put into practice, and everyone will hope that he will be as successful in the future as he has been in the past.

A. RUSSELL.

The Devil-Worshippers of Kurdistan.

The Cult of the Peacock Angel: a Short Account of the Yezîdî Tribes of Kurdistan. By R. H. W. Empson. With a Commentary by Sir Richard Carnac Temple. Pp. 235 + 6 plates. (London: H. F. and G. Witherby, 1928.) 15*s*. net.

TURKISH rule over alien peoples had some defects, but it had one merit which is of supreme importance in archæological eyes. Sporadic outbursts of political fanaticism apart, it left social, religious, and linguistic independence to the different races that were subject to it. Thus it preserved a great deal of material that is valuable to the modern student.

One of the most puzzling exhibits in what may be called the Turkish museum is the group of tribes known as Yezidis in their own habitat of Kurdistan and as devil-worshippers in Europe. They are very difficult to label accurately in detail. How far do they really worship the devil? Who is the 'peacock angel' whom they adore? Do they belong to any of the great religions of humanity; and if so, to which? What does the word 'Yezidi' mean? Of what race are the tribes? In the book under review, Mr. Empson sets out the answers which his reading and personal investigations enable him to offer to these and other questions.

In dealing with the first, he points out that a being like the devil who can do harm may be propitiated and consequently cajoled out of carrying his evil purposes into execution. Hence he considers that the Yezidis placate—with some exaggeration perhaps—rather than worship the devil. In the commentary which enriches Mr. Empson's book, Sir Richard Temple accepts this view and supports it by examples from India. Other examples exist in the Mediterranean area. Sailors, for example, placate the sea-demon of Cape Linguetta in Albania with offerings of bread. In the same spirit the ancient Greeks spoke the Black Sea fair and called it the Euxine, the Favourable, rather than the Axine which it was in reality.

As to the second question, Yezidis believe that the devil would be offended if he were named. Consequently they address their apotropaic cult of him to a proxy called Melek Taus, the 'peacock angel.' Sir Richard Temple attributes their choice of proxy to confused memories of the Mohammedan version of the temptation, in which a peacock appears as the intermediary between Eve and Satan. According to a legend related (was it collected?) by Mr. Empson, the Yezidis themselves say that Satan snatched Christ from the Cross. Failing at first to convince the women mourning by the empty tomb that he had done so, he took a dead cock and restored it to life to prove his power. Then, informing them that he wished to be worshipped thenceforth as a peacock, he vanished. Sir Richard is certainly happier in his suggestion than the Yezidis, for they have only borrowed the story of the empty tomb from the canonical Gospels and the story of the revival of a dead cock from such Christian legends as the early tale of St. James of Compostella and its Syrian prototypes.

Question three is most interesting. To answer it Mr. Empson gives details of the religious beliefs and customs of the Yezidis. These include respect for running water and for certain trees, sun worship, regard for fire, traces of dualism, baptism, a (rather cursory) fast of forty days in spring, belief in purgatory, reverence for Christ and the symbol of the Cross, blood sacrifices, circumcision, transmigration of souls, ablutions before worship, and certain funeral rites. On the evidence, Mr. Empson will say no more than that the Yezidi religion is highly syncretic. Sir Richard Temple, noting the Mohammedan environment of the tribes, calls it an extremist form of Islam with borrowings from the different religions with which the Yezidis have been brought into contact during their wanderings.

Writing after long and intimate experience of Bulgars, Greeks, and Albanians who have deserted Christianity for Islam, I would go further. I would regard the Yezidis as having passed successively from animism to Sabæanism (less probably Christianity) and finally to an imperfect form of Shia Islam. In my opinion funeral rites are the most decisive test of a faith. Most of the Yezidi funeral practices, notably the washing of the dead, the burial of sacred earth with him, the shielding of his remains from the surrounding earth, his inquisition by angels, and the funeral feast at his tomb, are Shia practices and range the Yezidis with the Shias. Turkish massacres of Yezidis are not inconsistent with this classification, for Turks have always hated sectarians of their own faith more than members of alien faiths. The massacres of Anatolian Shias by Sultan Selim and of Bektashis by Sultan Mahmud are cases in point.

By the theory of progressive, but always partial, conversion of the Yezidis from one religion to another, such anomalies as baptism in their present practice would be explained, more easily, as

survivals from their previous religion rather than as borrowings from neighbouring creeds. Such saints as Sheikh Adi would fall naturally into place as the propagandists responsible for the change of faith. Such minor difficulties as the Yezidi taboo on the name Gurgis would disappear. For Nebi Gurgis, Saint George, is a prominent Christian saint in the Mosul district near which most of the Yezidis live. As such, he would have had to be camouflaged as Khidr or disowned by the Yezidis at their adoption of Islam. In this connexion we wish that Mr. Empson had given us a list of Yezidi names.

As to the meaning of the word Yezidi, Mr. Empson seems to relate it like the Yezidis themselves to their alleged descent from the Caliph Yezid. Their racial origin he, very prudently, thinks must be left to anthropologists to solve.

Altogether the book is most interesting. Unfortunately bad planning has made it hard to read. Thus the chapter entitled "The Origin of the Yezidi Tribes" discusses the origin of three things, namely, the doctrines, race, and name of the Yezidis, but the discussion never separates one origin clearly from another; and in his next book, will Mr. Empson not name his authorities, and put subjects as well as persons and places in his index?

MARGARET HASLUCK.

An Eclectic Bibliography.

The Subject Index to Periodicals, 1926. Issued by the Library Association. Pp. ix + 278. (London: Grafton and Co., 1928.) 70*s*.

THE desirability of possessing lists of references, kept as up-to-date as possible, is apparent to every investigator, whatever the field of knowledge in which his interest lies. For the individual to compile his own subject index from original sources of information, an enormous amount of time and labour is required. It is the function of published 'bibliographies' to provide him with the required material in the form of references to original papers and, in some cases, as abstracts of the articles to indicate their scope. There are two requirements which a list of references must fulfil if it is to be of real practical value: it should be as complete as possible; and it should be suitably classified by subject. No bibliography, however specialised, is complete. No bibliography can be complete. In the restricted field of science alone, the number of articles published each year is probably of the order of one million, and these are distributed through some fifteen thousand current scientific periodicals ("The World List of Scientific Periodicals," of which vol. 1 was published in 1925, and which was admitted to be incomplete, contained entries of more than 24,000 scientific periodicals in existence since 1900). Of this number of articles a comparatively low percentage is indexed in bibliographies. A great proportion is lost to those investigators to whom they would be of extreme use. It is true, of course, that the majority of articles of outstanding importance are mentioned in abstract or reference journals; but who is to determine the value of an article to an individual?

The first thing that one would welcome, therefore, in a modern subject index is a wide range of literature covered.

The second important feature is an efficient classification according to subject. In this, the majority of indexes are sadly deficient. At least one hundred and fifty systems of classification have been devised, but editors of indexing journals, in most cases, are very shy of adopting any system, however valuable it may have been shown to be in practice.

In the light of these two considerations, scope and classification, it is interesting to consider the present publication of the Library Association. The "Subject Index to Periodicals" was begun in 1915 to provide a general index to periodical literature. Volumes were issued, either as consolidated volumes or as Class Lists, covering the literature up to 1922. The work of publication became considerably in arrear, and in order to bring it up to date the volume for 1926 has now been issued. The volumes for 1923 to 1925 are in course of preparation.

The volume for 1926 contains some 21,000 entries, covering about 600 periodicals. The Class List arrangement is discontinued, the arrangement of the present edition being alphabetical by subjects, based upon the Alphabetical Subject Headings of the Library of Congress. The classification possesses the well-known disadvantages of an alphabetical system of classification, but in practice the system used here appears to be as convenient and useful as this method of classification can be.

It is in the very small range of literature covered, that the chief source of disappointment lies. The work is not confined to scientific subjects, and yet it deals with only 600 periodicals, whereas in the field of science alone there are some 15,000 current periodicals. No serious attempt seems to have been made towards a judicious selection of the type of periodicals selected for indexing, or to a discrimination between articles according to their obvious value as sources of new or sound information.

For the scientific investigator the work is of little value. It cannot hope to compete with the well-known specialist abstract journals. Moreover, it is stated in the preface that a few of the more technical periodicals, which are covered by printed abstracts, have been excluded. The method of selecting the periodicals for exclusion seems to be very arbitrary. For example, the *Philosophical Magazine* is included, while the *Proceedings of the Royal Society* is omitted. Many of the popular scientific journals are indexed, while most of the important journals containing original papers are excluded.

For public libraries the work may have its uses. But even here it would need to be used in conjunction with other bibliographies. Otherwise, a very erroneous impression of the literature of a particular subject will be obtained. If one may be excused making suggestions, the following would appear to be the system of editing which would make the work of greatest value: That in future editions the guiding principle be that of providing the ordinary non-specialist, who uses chiefly a public library, with a survey of the most important papers published on the subjects in which he is interested. That the most satisfactory way of achieving this would probably be to use the services of a staff of specialists. Each specialist would be acquainted with the literature of his subject, and would provide a list of references to the most important articles on his subject, gleaned from as wide a range of journals as possible. In this way a bibliography would result which would be of far greater value than that compiled by indiscriminate indexing of articles, good and bad, from a limited number of periodicals, and excluding many of the most important sources of information.

It is not the intention of this note to belittle the work done by the Library Association and its large number of voluntary contributors. Their work is very praiseworthy, and is purely a labour of love. It is rather to suggest that the results of their labours would be of greater value if directed along lines somewhat different from the policy which appears to be followed at present. W. CLARK.

Biology of Insects.

The Biology of Insects. By Dr. George H. Carpenter. Pp. xv + 473 + 16 plates. (London: Sidgwick and Jackson, Ltd., 1928.) 16*s*. net.

IN the insects, perhaps more than in any other group of animals, the biological interest outweighs the morphological. In fact, as Dr. Carpenter says in his preface, the great wealth of facts makes a careful choice of material not only necessary but also very difficult. Any omission is sure to disturb some critic. The plan of Dr. Carpenter's book is reminiscent of that adopted in many recent German text-books. The structure, physiology, and sense-organs are described in the earlier chapters, while the later ones show what use insects make of their endowment.

This treatment leads to six (out of the total of fourteen) of the chapters being predominantly concerned with morphology. Perhaps, if the amount of morphology had been reduced, especially in those aspects which Dr. Carpenter has treated more fully in his previous books, room might have been found for certain topics that have not, or only inadequately, been treated. The question of parasitism and its relation to and development from the carnivorous habit would have provided the material for a long and interesting chapter on a subject of increasing economic importance. The last chapter, on insects in relation to mankind, is full of 'old familiar faces,' while some of the interesting modern work (*e.g.* in Australia) is unmentioned. There is little exposition of the principles governing applied entomology; no indication, for example, of the difference between attacking a pest living in its native country and one which has recently been introduced into an area where its enemies are lacking; nor are the causes of insect outbreaks discussed in any detail.

These objections are not, perhaps, altogether admissible against a book which will, in any case, contain a great deal which is new and interesting to those who are not specialists in the subject.

In certain cases recent work has made it necessary materially to modify some of Dr. Carpenter's statements. Thus, on p. 145, the generalisation that "in every case we find the form and action of an insect's ovipositor suited to the position in which eggs have to be placed" is very sweeping. In the case mentioned of Phasgonurid grasshoppers, Grasse has actually shown (*Bull. Biol. France et Belgique*, **58**, p. 454; 1924) that species with similar ovipositors often lay their eggs in very different substrata and vice versa. The statement on p. 202 that it is the brighter-coloured sex which carries the other on the nuptial flight has not been borne out by recent observations. Warren (*Ent. Record*, **32**, p. 218; 1920) points out that while the greater activity of one sex or the other in the nuptial flight is highly specific to particular genera or families, it is not generally correlated with colour. The account of the solitary bees, *Halictus*, on p. 225, is defective, for Stöckhert (*Konowia*, **2**,

p. 48; 1923) has recently shown that many species are truly social and have a real worker caste, offspring of the hibernated females. In the interesting summary of the activities of termites (p. 253) there is no account of Cleveland's work proving that termites are able to eat such quantities of cellulose only by the help of their symbiotic intestinal ciliates. The acceptance of Dr. Harrison's interpretation of his experiments with the gall-making sawfly, *Pontania*, is a more debatable point. The proof that the instinct to lay on a new food-plant has been impressed on the germ-plasm is by no means rigid; it is equally possible that the experience of the larva of the special chemical properties of the new food-plant has been handed on to the adult with the larval central nervous system, which is little modified in metamorphosis. Such a method of instinct-evolution may well be very important amongst insects; it is possible that some of the pests which have arisen in recent years through alteration in the normal food-plant (*e.g. Orchestes fagi*, p. 111) illustrate the same process.

Of the illustrations, the photographs (many of them taken by Mr. H. Britten) are excellent, both in their technique and in the story they tell. There is a useful bibliography and index, though the latter, unfortunately, does not include the names of authors mentioned in the text. No misprints have been noticed, but on p. 381 *Scæva dryadis* is a fly and not an aphis; this mistake, however, is due to an error in the work there quoted. On p. 382 also, *Leria* (fam. Helomyzidæ) would not normally be called a midge. Dr. Carpenter's book is likely to provide many with a useful introduction to a very large subject.

Microscopic Life in Drinking Water.

The Microscopy of Drinking Water. By Prof. George Chandler Whipple. Revised by Prof. Gordon Maskew Fair and Prof. Melville Conley Whipple. Fourth edition, rewritten and enlarged. Pp. xix + 586 + 19 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 35*s*. net.

THIS book deals with a subject which is of practical importance to the water engineer, and presents at the same time a biological problem of a quite fascinating kind, namely, the symbiosis, to use the word in a purely literal sense, of microscopic organisms. One can imagine with what keen interest Darwin would have reflected upon the problem, if the materials for its study had been available to him. Let it be said now that this is a well-written and well-arranged treatise, which combines an enthusiastic interest in the subject with a sound judgment upon its practical aspects. Naturally, perhaps, American experience has been drawn upon for the purpose of illustration, and yet the book would have gained in comprehensiveness if the editors had given more space to the observations of workers in other countries.

The term 'microscopic organisms' is virtually equivalent to the term 'plankton,' and relates to the organisms (except the bacteria) that are invisible to the naked eye, and inhabit streams, lakes, ditches, and other bodies of fresh water. The common organisms in drinking water include algæ, fungi, protozoa, rotifera, crustacea, bryozoa, and sponges. Taken altogether, 187 genera—108 plants and 79 animals—have been recorded, but of these only 10 genera cause serious trouble. The bacteria are not considered in this volume. They make drinking water unsafe, whereas the microscopic organisms make it unsavoury. These organisms do not thrive in grossly polluted water, and therefore they do not indicate pollution of the water by sewage.

From the point of view of the biologist the study of the microscopic organisms concerns the mutual relations, whether helpful or inimical, of their life processes, and their reactions to the physical environment and to more highly developed types of living organisms. Thus fresh-water fish feed on crustacea and insect larvæ; the crustacea prey upon rotifera and protozoa; the rotifera and protozoa feed on algæ and bacteria; and the algæ absorb soluble substances and gases provided in part by the decomposition of animal and vegetable matter brought about by bacteria.

The circumstance that the microscopic organisms are more numerous in the surface layers of lakes and reservoirs than in the deeper strata is doubtless explained as an effect of light, which stimulates the metabolism of the chlorophyll-containing organisms by inducing photosynthesis, the process whereby carbohydrate food materials are built up from carbon dioxide and water. Temperature has a marked effect on the plankton, and it would have been interesting if reference had been made to the influence of this factor upon the water supplies of tropical countries. Aeration is another important factor. Chambers found that aeration tends to the formation of individual cells of algæ, and that in poorly aerated water the tendency is rather towards the production of colonies and filaments. The hydrogen-ion concentration of samples of water taken from varying sources and under varying con-

ditions, and its relation to the plankton, is a part of the subject which until recently has been inadequately investigated owing to the lack of a sufficiently simple technique.

An interesting chapter deals with the microscopic organisms met with in water pipes and aqueducts. Here the absence of light and the growth of sponges on the walls are not favourable to the plankton. Covered conduits harbour fungi, sponges, hydrozoa, bryozoa, crustacea, insect larvæ, worms, and molluscs. 'Pipe moss' is the popular name for the branching furry growths of hydrozoa and bryozoa.

The somewhat ill-defined group of organisms which includes leptothrix and crenothrix has many times been a source of trouble in water supplies. They are filamentous forms and are surrounded by a sheath upon which ferric oxide or hydroxide may be precipitated. If present in excess they give a milky appearance to the water or a rusty-iron colour, and a musty, fishy or otherwise disagreeable odour.

Much has yet to be learned concerning the chemical nature of odoriferous substances derived from microscopic organisms. In most cases the odour is caused by compounds analogous to the essential oils, and in many genera the oil globules may be seen within the cell, especially before sporulation or encystment. The cucumber taste and odour have been a frequent cause of complaint against the Boston water supply. This was at first attributed to a sponge (*Spongilla fluviatilis*), but it is probably due to *Synura*, a free-swimming protozoon grouped in "subspherical social clusters" and commonly present in swamp waters. The aromatic odours sometimes associated with drinking water are due chiefly to the diatomaceæ. Two species of protozoon possess an aromatic odour; *Cryptomonas* smells of violets and *Mallomonas* has a similar odour, which, however, when strong, becomes fishy.

An account is given of the method devised by Moore and Kellerman (1904) of controlling algal growths in water supplies by means of copper sulphate. Mention is made of the plan of scattering the copper sulphate on the frozen surface of reservoirs, thereby ensuring a uniform distribution when the ice melts. This salt does not exterminate the algæ, and the resistant cells survive to act as a seed for a later outbreak. There is no evidence that the organisms acquire resistance to the repeated action of the copper sulphate. Chlorine is preferred by some as an algicide, and its addition in amounts greater than the minimum lethal concentration destroys the odour and taste-producing oils that are liberated from the dead plankton. The removal of the excess of chlorine is effected by means of sulphurous acid, or sodium sulphite, bisulphite, or thiosulphate.

The second part of the book is devoted to a systematic account of the classification and characteristics of the microscopic organisms which are met with in drinking waters. G. F. P.

Text-books of Physical Chemistry.

(1) *Introduction to Physical Chemistry.* By Sir James Walker. Tenth edition. Pp. xii + 446. (London: Macmillan and Co., Ltd., 1927.) 16*s*. net.

(2) *Elementary Physical Chemistry.* Adapted from "A Treatise on Physical Chemistry." By Prof. Hugh S. Taylor. Pp. ix + 531. (London: Macmillan and Co., Ltd., 1927.) 16*s*. net.

(3) *Theoretical and Experimental Physical Chemistry.* By Dr. James Codrington Crocker and Dr. Frank Matthews. Pp. viii + 581. (London: J. and A. Churchill, 1927.) 21*s*. net.

(4) *Lehrbuch der physikalischen Chemie.* Von Prof. Dr. Karl Jellinek. Fünf Bände. Zweite, vollständig umgearbeitete Auflage. Band 1: *Grundprinzipien der physikalischen Chemie, die Lehre vom Fluiden, Aggregatzustand reiner Stoffe.* Pp. liv + 966. 82 gold marks. Band 2, Lieferung 4. Pp. 272. 21 gold marks. (Stuttgart: Ferdinand Enke, 1928.)

(1) WALKER'S "Introduction to Physical Chemistry" appears to share with Roscoe and Schorlemmer's "Treatise on Chemistry" the gift of perpetual youth, if not of immortality, since it has now reached a tenth edition, and shows no signs of decay in its twenty-ninth year. There is perhaps something in common which keeps these books in steady demand over so long a period of years, and that something (it may be surmised) is a sound appreciation of values, which has led to the retention of things that matter, even if old, and to a cautious inclusion of new matter only if likely to be of permanent utility. In other words, the secret of youth seems to depend on permitting a natural process of ageing and avoiding artificial efforts to keep young.

The present period is a trying one for writers of books on physical chemistry, since it is not easy to adhere to the new doctrine of 'complete ionisation' and yet to do justice to the older doctrine of 'reversible ionisation,' which was embodied in Arrhenius' theory of 'electrolytic dissociation.' In the present edition this problem is faced quite frankly, but it is treated with such care and

discretion that there is little risk that the teacher will have to recall his words, or that the student will have to unlearn what he has been taught.

The inclusion of Rast's cryoscopic method, with camphor as the solvent, and of Baker's later experiments on the effects of intensive drying, are indications that the work done in the five years which have elapsed since the appearance of the ninth edition is sufficiently represented in the tenth edition; and this impression is confirmed by the up-to-date character of the further literature which the student is advised to read. The advice to 'read Walker' can therefore still be given with confidence to those who want to lay a sure foundation of knowledge of physical chemistry.

(2) It has always been a problem to know what book to recommend to the pass student who has 'read Walker' and now wishes to study a more advanced book for an honours course. There are a few brilliant students who can read a series of books on solutions, on thermodynamics, on catalysis, on atomic structure, and on valency, and then proceed to study the general discussions of the Faraday Society, and some students of equal ability may attempt to master the 1359 pages of H. S. Taylor's "Treatise on Physical Chemistry"; but these Herculean labours cannot safely be imposed on the honours student who is not a specialist in physical chemistry, and whose chief interest may be in some other branch of chemistry.

For students such as these, the abbreviated version of 'big Taylor' now published as an "Elementary Physical Chemistry" may be commended, since it creates immediately a new atmosphere, instead of merely telling the same story with a few additional details. Thus the first chapter on "The Atomic Concept of Matter" is dominated almost at once by nuclear and extranuclear electrons and their application to chemical theory; and in the same way the second chapter makes an early start with the thermodynamical problems which form the last chapter of Walker's "Introduction." The problem of "Energy in Chemical Systems" is thus put in the forefront of the book; and this characteristic is maintained in the later chapters, where thermodynamic treatment is used freely.

An interesting contrast is seen in the two chapters on ionic equilibria. The first deals with 'weak electrolytes' in the traditional manner, whilst the second deals with 'strong electrolytes,' from the point of view of the thermodynamic activity, and the Debye-Hückel theory of conductivity. The revision of earlier methods of teaching is here complete and entirely satisfactory; but revision is still urgently needed in the treatment of catalysis, which is discussed as if hydrogen and hydroxyl ions were the only possible catalysts in aqueous solutions, and as if neutral salts could only act by stimulating a hydrogen ion to greater thermodynamic and catalytic activity. This view is a legacy from the days when the theory of electrolytic dissociation was first exploited, and the time has already come when it should be 'scrapped' along with some other too-hasty deductions and assumptions of that period, for which the present volume provides a decent interment.

(3) Drs. Crocker and Matthews claim to have had twenty years' experience in teaching physical chemistry, but in this period they appear to have produced only about seven original papers, including one on which the names of both authors appear. This is not in itself a disqualification for writing a text-book, but it deprives the book of the adventitious aid which a text-book necessarily receives when the names of the authors are widely known as writers of authority in their own field.

The scope of the book is very similar to that of the two preceding volumes, since it is intended to include in a single volume the material necessary for an honours degree. In reality the standard of difficulty is a little higher than that of Walker's "Introduction," whilst it is certainly below that set by Prof. Taylor. Bold printing, short chapters, and a liberal series of 145 well-drawn figures make the book an easy one to read, and the questions which are usually included in an honours course of physical chemistry are adequately discussed.

If, therefore, no other alternative were available, the book could be recommended as satisfying quite well the requirements of students taking such a course. On the other hand, in the opinion of the reviewer, it does not give promise of displacing either of the two preceding volumes, since Walker's didactic skill is still without a rival in this field, and Taylor's wider experience enables him to write with greater authority when dealing with controversial questions or with unsolved problems. The student would therefore lose rather than gain as a result of paying five shillings more for the larger volume.

(4) Prof. Jellinek's "Lehrbuch der physikalischen Chemie" consists of five volumes, which it is proposed to issue yearly in three parts, at a price which will be increased by 10 to 15 per cent above the present subscription rate when the whole volume is complete. The present instalment includes the first volume of about 1000 pages at

82 marks, and one-third of the second volume, ending abruptly in the middle of a sentence on p. 272, at a cost of 21 marks. The complete work may therefore cover more than 4000 pages and cost perhaps £20. A work of this size is too big to be used as a text-book, especially when the student has to read it in a foreign language; but it is the type of book which German authors have a special skill in producing and English readers are sometimes glad to consult. The appearance of a second edition may be taken as evidence that there is a market for such a book, either in its country of origin or abroad. T. M. LOWRY.

Nitrogen and Phosphorus.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 8: *N. P.* Pp. x + 1110. (London: Longmans, Green and Co., Ltd., 1928.) 63*s*. net.

THE eighth volume of Mellor's "Comprehensive Treatise" carries the simple sub-title N.P., recalling the equally simple sub-title of the first volume, H.O. It is in many respects a critical volume, since the chemistry of nitrogen (and in a lesser degree the same statement may be made of phosphorus) has undergone an extensive transformation in many of its aspects since the first volume of the treatise was issued in 1922, and it might very well have happened that the treatise would have lagged behind, and shown signs of being a little out-of-date at this stage. A study of the new volume immediately dispels this fear, since the author has had an almost uncanny success in searching out even the least pretentious of post-War publications and setting them in place in his narrative.

This feature of the new volume is well illustrated by the sections on "The valency of nitrogen" and on "The constitution of the ammonium compounds and the ammines," where the old historic formulæ are retained in their proper setting, but are supplemented on one hand by Werner's formulæ and on the other hand by formulæ based upon the electronic theory of valency. The author's treatment of co-ordination compounds is indeed exceptionally able and authoritative, although he has not had the opportunity of acquiring this authority by original work on the subject.

The section on "Allotropic forms of nitrogen" bears the same testimony to the author's skill and perseverance in keeping his narrative up-to-date, since physical and chemical observations are cited right up to 1927, including the contents of a number of letters to NATURE, which are quoted along with the more substantial contributions to scientific literature.

The sections which deal with the fixation of nitrogen have the same general character as the rest of the volume, since the author gives a very large range of references to original literature, without attempting to supply full details of technical processes, although several of the principal types of electric furnace are illustrated by simple diagrams. The sections on various nitrogen compounds contain some unfamiliar information, as, for example, that a freezing-point diagram can be drawn to demonstrate the crystallisation of solid N_2O_3 from a mixture of NO and N_2O_4, and that nitric oxide forms a transient compound with chlorine of the composition $NOCl_2$. The existence of NOBr, $NOBr_2$, and $NOBr_3$ is also indicated by the same methods.

Phosphorus provides less scope than nitrogen for interesting paragraphs, but is discussed with equal efficiency. The polar formula for phosphorus pentachloride should, however, have been attributed to Langmuir, and Sugden's evidence for the existence of a semi-polar bond in phosphorus oxychloride might have been cited. The formulæ assigned to the polyphosphoric acids are of an old-fashioned type, in which the phosphorus is generally quinquecovalent, but they are scarcely open to criticism in a treatise which has a definite historical character since the formulæ are generally those of the author whose work is being described.

Dr. Mellor is obviously not flagging in the Herculean task that he has undertaken, but on the contrary proceeds "from strength to strength," and can certainly be congratulated on the vigour and efficiency of the latest section of his work.

Marriage and Maternity.

Hymen: or The Future of Marriage. By Norman Haire. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1927.) 2*s*. 6*d*. net.

Motherhood and its Enemies. By Charlotte Haldane. Pp. vi + 256. (London: Chatto and Windus, 1927.) 6*s*. net.

(1) MANKIND being what it is, marriage must be unsuccessful in the great majority of cases. It is so because of the general ignorance of matters relating to sex, the result of a faulty sex-education, and because of prejudices, the fruits of faulty standards of sex-conduct based on the

religious and social prohibitions which doubtless once served their purposes but are now most certainly anachronous. The standards of to-day are those of the ancient Israelites as modified by the Christian Churches, and more often than not have no relation to biological fact or to modern social needs.

Mr. Norman Haire makes two assumptions. Normal sexual activity should be made possible when once puberty has been attained. Sexual congress is the primary object of marriage. He argues that there must be either early marriage with controlled fertility and easy divorce, or else premarital experience with controlled fertility, safeguards against venereal diseases, and the removal of the stigma of illegitimacy. Though he is of the opinion that the lifelong monogamous marriage is the ideal, he does not give his reasons for this opinion, and suggests that legalised polygamy will be required for the majority. He foresees the development of male prostitution, and of the eugenic conscience. One can read the book in half an hour, but to destroy or to banish its arguments will require much longer.

(2) An attitude that is commonly regarded as typically masculine is expressed in this book by one who certainly is characteristically feminine. The author, in seeking an explanation of certain aspects of sex relationships, has, with an energy that is remarkable, traced the historical development of woman in her relation to man and to the community from the earliest times, extracting from her records recipes for the cure of modern ills. She depicts the relative licentiousness of the women of the pastoral Jews, the harem-like existence lightened by the institution of slavery reaching its zenith in ancient Greece, the institution of the class of exalted prostitutes, the period of the deterioration of the respectable woman and the abasement of the prostitute class in Rome, the inception of Mary-worship and the development of celibate female orders, the middle-class revolution with its development of a social and economic ambition on the part of woman, the lessening of the incentive to maternity and the coincident increase in the demands for personal freedom resulting in the spread of feminine celibacy, and finally the effects of the War upon the position and the attitudes of women.

The author concludes that the position and the attitudes of woman to-day are the results of the introduction of Christianity with its praise of the celibate, the abolition of slavery, and of the competition of home and industry. There exists a widespread and exaggerated sentimental adulation of motherhood associated with an increasing unwillingness on the part of women to undertake its duties. She holds that the sexually normal woman is one whose career leads or should lead to mating and motherhood, and that the real enemy of motherhood is the non-reproducing female intersex who deviates more or less markedly towards the male type. In the past it has been the least womanly who have fought the battle of their sex's emancipation: it is the elderly virgin that has nurtured sex-antagonism, competing with the male economically and refusing to conform to his ideals of sex relationship. The present conflict of the sexes is due to the anti-biological influence of the Christian religion in the past and to the recent activities of the non-reproducing women, who, whilst being biologically superfluous, are socially and politically influential.

Mrs. Haldane deals with her opponents not gently; she uses the bludgeon somewhat too readily, but certainly she scores her points.

F. A. E. CREW.

Systems of Forestry.

Silvicultural Systems. By Prof. R. S. Troup. (Oxford Manuals on Forestry.) Pp. xii + 200 + 43 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 21*s.* net.

THE destruction of natural forests still continues throughout the world. In Russia, Canada, and the United States, where the great bulk of softwood (*i.e.* coniferous timber) is produced, the lumbering operations of private owners as a rule are purely destructive, since no efforts are made to secure the growth of a second crop of timber trees on the felled area. As a consequence, a famine in the world's supply of timber is predicted to come in thirty or fifty years' time. Is there no remedy? Can the problem of the world's future timber resources be solved? The answer is that in France and Germany scientific methods have been gradually evolved, by means of which the original forest areas are not only conserved but also rendered more productive. In the so-called 'managed forests' of these countries, new crops of trees come in succession on the ground, and the highest possible yield of timber is extracted year after year. This regular 'sustained yield' is much more economical than intermittent or spasmodic yields.

The different modes of scientific treatment of the forest, current on the continent, are technically called 'silvicultural systems,' and can be grouped

into about a dozen forms. Transferred from Europe, these systems have been successfully applied in the government forests of India and the United States, and with suitable modifications could be practised in Great Britain.

The various systems are carefully explained by Prof. Troup in this excellent text-book, which is aptly illustrated by full-page reproductions of photographs of actual forests. Owners of large woodlands and working foresters will find the subject presented in an interesting manner. Local examples are cited, so that the book will serve as a guide to students in quest of practical knowledge of the various systems. Botanists will be interested in the varied and often peculiar cases of natural regeneration in wild and cultivated species, as teak in Burma, white mulberry in India, lodge-pole pine and Douglas fir in North America. The seedlings of the last species often arise in areas devastated by fire, from seed stored in the ground.

The oldest system known is that of coppice, which was systematically practised by the Romans for the production of firewood, vine-stakes, and other small material; and short rotations were adopted, eight years for chestnut and eleven years for oak. The coppice system is still used in England to grow oak, ash, chestnut, and hazel. Coppice with standards is another useful system on private estates, where it is utilised partly for game preserves and partly for fencing material. This system has been employed since the twelfth century at Melton Constable in Norfolk. Plantations of exotic species, as larch, spruce, silver fir, and Corsican pine, are usually worked on the clear-cutting system in England. This practice is now imitated in South Africa, Australia, and New Zealand, where certain North American species are more profitable to grow than the native trees.

Quantum Mechanics.

The New Quantum Mechanics. By George Birtwistle. Pp. xiii + 290. (Cambridge: At the University Press, 1928.) 16*s*. net.

WHEN the history of the progress of atomic physics during the twentieth century comes to be written, three dates will certainly occupy prominent places; 1900, when Planck published his researches on the discontinuous emission and absorption of energy; 1913, when Bohr derived the Balmer series and Rydberg's constant in terms of known physical quantities from a consideration of Rutherford's model of the atom; and 1925, when the new theories of quantum mechanics were originated.

Mr. Birtwistle has already dealt with the state of the quantum theory immediately prior to the new work in "The Quantum Theory of the Atom." The present book resumes the story from 1925. In this crucial year, Heisenberg enunciated his new scheme of quantum kinematics in which the dynamical equations retain their classical form but in which the commutative law of multiplication does not hold. This is effected by replacing the classical representation of a variable in Fourier series by a matrix or table of terms built up from those magnitudes which are experimentally observable. Concurrently with this, Dirac, working on independent lines, found that the quantum conditions could be expressed by the Poisson bracket of classical mechanics. He further showed that difficulties of devising a suitable scheme of matrix differentiation could be avoided by his method, the matrix representation being only necessary to interpret the functions of the dynamical variables used in terms of the ordinary numbers in which the results of experiment must necessarily be obtained. In the same year the theory of the spinning electron was given by Uhlenbeck and Goudsmit. This theory enabled Heisenberg and Jordan to prove the g-formula, previously obtained empirically by Landé, and also to justify Sommerfeld's formula for the Paschen-Back effect.

While these theories were being explored, Schrödinger seized on the new ideas of de Broglie as to the waves associated with matter and attacked the atomic problem from an entirely different aspect, by assuming that in the case of mechanical systems of the atomic scale of smallness the phenomena should be represented by a wave motion rather than by the motion of a mass-point. He derived a differential equation for the wave function, and by means of the *eigen* functions obtained from this equation he was able to throw a fresh light on atomic phenomena. Moreover, Dirac was able to derive the Heisenberg matrices from the *eigen* functions.

Schrödinger's work was from the mathematical point of view a great advance, since the theory of differential equations on which it is based is not only more familiar but is also a more developed branch of analysis, and lends itself readily to arithmetical computation.

In the present book the author presents a complete, reasoned, and eminently readable account of all these theories. Those who have read the original memoirs as they have appeared will

welcome this able summary of their important features, while others about to enter this new field will be glad to have available an account of the theories up to a definite date which will give them an opportunity of contending with the new work which is continually appearing. The subject of the last chapter, "The essential indefiniteness of quantum mechanics," has also been dealt with by Bohr in a recent Supplement to NATURE (N. Bohr, NATURE, April 14, 1928), but this need not be regarded as a pessimistic augury for the future of a field of inquiry which has all the vigour of its youth.

L. M. MILNE-THOMSON.

Brains of Apes and Men.

The Brain from Ape to Man: a Contribution to the Study of the Evolution and Development of the Human Brain. By Prof. Frederick Tilney. With Chapters on the Reconstruction of the Gray Matter in the Primate Brain Stem, by Prof. Henry Alsop Riley. In 2 volumes. Vol. 1. Pp. xxvii + 473. Vol. 2. Pp. xv + 475-1120. (London: H. K. Lewis and Co., Ltd., 1928.) 105*s*. net.

THIS massive and expensive treatise—it weighs 11 pounds 9 ounces and its price is 5 guineas—consists mainly of descriptions of the (macroscopic) form and proportions of the grey matter in the brain stems of a series of Primates. The purpose of this immense labour is not altogether apparent: for the descriptions are vague and often meaningless. The photographs that are reproduced as half-tones are for the most part blurred and indistinct; and the line drawings that are intended to interpret these indistinct photographs exaggerate their defects and in some cases introduce errors not in the photographs.

It is, however, not merely the records of his own observations and the figures that display inaccuracies. Prof. Tilney's references to other writings are untrustworthy, and in some cases the misrepresentation of the views of other anatomists is so gross as completely to invert their real opinions.

The investigations of the last thirty years have emphasised the fact that the progressive modification of the visual centres is the cardinal factor for the correct interpretation of the distinctive features of the Primate brain and the explanation of its evolution. Yet in this massive treatise on the Primate brain not only is there no reference to this matter, but also, what is even more astounding, in the closely printed 28 pages of bibliography there is no mention of (nor in the text any suggestion of acquaintance with) the work of such authorities as Monakow, Ariëns Kappers, Brodmann, Minkowski, Brouwer, and in fact most of those who have created our modern knowledge of the Primate brain!

In his foreword Prof. Henry Fairfield Osborn informs the reader that this treatise "contains the basis of what to our knowledge is the first profound study of the genesis of the intimate and internal structure of the human brain in comparison with the brains of animals more or less nearly related to man"! This daring claim could be made with any semblance of justification only by a writer who assumes that his readers are unacquainted with the works of the great neurologists of the nineteenth century and the modern treatises written by Monakow, Edinger, Ariëns Kappers, Brodmann, Oskar Vogt, Rademaker, Anthony, Brouwer, and scores of others whose work has been ignored by Prof. Tilney.

G. ELLIOT SMITH.

Scientific Backgrounds.

(1) *Religion and Science: considered in their Historical Relations.* By Charles Singer. (Benn's Sixpenny Library, No. 144.) Pp. 79. (London: Ernest Benn, Ltd., 1928.) 6*d*.

(2) *Kant's Critique of Teleological Judgement: Translated, with an Introduction, Notes and Analytical Index.* By Dr. James Creed Meredith. Pp. xcvii + 208. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) 12*s*. 6*d*. net.

(3) *The Unique Status of Man.* By Dr. Herbert Wildon Carr. Pp. 216. (London: Macmillan and Co., Ltd., 1928.) 7*s*. 6*d*. net.

(4) *Nature and God: an introduction to Theistic Studies, with special reference to the Relations of Science and Religion.* By Prof. William Fulton. Pp. xvi + 294. (Edinburgh: T. and T. Clark, 1927.) 9*s*.

(5) *Naturalism and Religion.* By Prof. Dr. Rudolf Otto. Translated by Prof. J. Arthur Thomson and Margaret R. Thomson. Edited with an Introduction by the Rev. W. D. Morrison. Reissue. Pp. xi + 374. (London: Williams and Norgate, Ltd., 1928.) 6*s*. net.

WITH the increasing specialisation of scientific study, men of science are feeling the need of providing their own particular field with some more general background. Hence an increasing interest in the history and philosophy of science. Dr. Singer's small yet admirable book in Messrs. Benn's series (1) is not a history of the development

of science, but a sketch of the relations in the past between the scientific and the religious interests. The author does not confine himself to modern developments, but goes back to the Ionian Greeks of the sixth century B.C., and carries us through the ancient and medieval periods to the modern. One notes with interest that he does not attribute the decline of the science of antiquity to the rise of Christianity.

"Despite the spread of philosophy based on science, the observational activity of antiquity was slowly dying in the pagan world from about 100 B.C. About A.D. 200 it expired with Ptolemy and Galen. The decay of observation, as we have seen, was the result of internally acting causes. In origin it had nothing to do with Christianity, which was not yet in a position to have its full effects on pagan thought."

Apparently, an important difference between our present attitude and that of the ancients was that whereas modern science has led to an attitude of optimism by giving us control over Nature, the science of antiquity offered no such control and led to an attitude of pessimism, since Nature seemed indifferent or hostile to man. This pessimistic attitude is displayed in Lucretius as well as in Marcus Aurelius. It is interesting to speculate whether science would lose any of its popular prestige to-day if it seemed to warrant an attitude of cosmic pessimism. Perhaps not unless its practical results were felt to be inimical to life, as the people in "Erewhon" felt to be the case with mechanical science.

Men of science in general are unwilling to suppose that either metaphysical or practical considerations can affect the future of science. Nevertheless, it is probable that more students of science are interesting themselves in philosophical problems than ever before, perhaps because science itself is becoming metaphysical. If this is so, it is not only philosophers who will be grateful to Dr. J. C. Meredith for his edition (2) of "Kant's Critique of Teleological Judgement" with the excellent introductory essays and very useful analytical index. Biologists especially will be interested in a work which discusses so acutely the relationship and meaning of mechanism and teleology. The 'critical philosophy' of Kant seems especially useful and even congenial to students of science, since, as Dr. Meredith says, it "just marks out bounds, and leaves it to Science, Art, and Ethics each to build what it is able on its own ground."

With regard to the metaphysical tendencies of science to which we have referred, physics has certainly become involved in them; and it is difficult, if not impossible, for biologists and psychologists to avoid contact with problems of a definitely philosophical nature. Dr. Wildon Carr's admirable sketch of present tendencies of thought (3) makes this clear. He indicates with great clearness the change of outlook which has taken place, by means of a contrast between the two opposing views.

"The philosophical world to-day," he writes, "is divided into two hostile camps. The ideal of the one is to be able to reduce all the phenomena of life and consciousness to the law of reciprocity, the law of the equivalence of action and reaction. The real universe is conceived as an interlocking mechanism, in which change, novelty, creation have no place. In philosophy they are materialists or natural realists. In science they are absolutists. In psychology they are behaviourists. In ethics they are deterministic and naturalistic. . . .

"The ideal of the other is to interpret all the phenomena of nature in accordance with the law of freedom, as it is experienced in the spontaneity and self-determining character of the activity of the individual. The real world is the living world. Inertia, materiality, necessity, are derivative aspects of the world, relative to the mode of living activity and its determination in actions. Those who fight under this banner are idealists in philosophy, relativists in science, voluntarists in ethics."

Altogether, this is a most interesting book, written in an easy and popular style. Not less interesting, but perhaps rather more academic in *format* and style is Prof. Fulton's work (4). He is concerned chiefly with what is, of course, the central problem, that of purpose, for theism in any form must stand or fall with this. What will interest the scientific reader most, perhaps, are two points. In the first place Prof. Fulton rejects the idea of unconscious purpose, which indeed does appear to be a contradiction in terms. In the second place, he rejects external or 'deistic' views of the divine nature and mode of action. If this is characteristic of modern tendencies in theology, certain reformulations of doctrine would appear to be due, since deistic notions are quite prevalent in orthodox circles, though not invarably recognised as such by those who hold them. The book is ably and closely argued, contains very numerous references to current literature both scientific and philosophic, and, in short, is an admirable work to place in the hands of anyone who wants guidance through the intricacies of modern speculation.

The public will be very grateful to the publishers for arranging a reissue (5) of Dr. Rudolf Otto's "Naturalism and Religion," published originally in 1907. Though now no longer new, the book is still

of exceptional value. Along with the late Prof. James Ward's "Naturalism and Agnosticism," it played no small part in bringing about a change of view which (as we have seen above) has recently been reinforced from the side of scientific research itself. The numerous readers of Dr. Otto's notable work, "The Idea of the Holy," will turn to this earlier book with much interest. J. C. H.

Hæmoglobin.

The Respiratory Function of the Blood. By Joseph Barcroft. Part 2: *Hæmoglobin.* Pp. ix + 200. (Cambridge: At the University Press, 1928.) 12*s*. 6*d*. net.

THIS second part of "The Respiratory Function of the Blood" sustains the description given to the first edition of the book by its author, as the story or log of his physiological explorations, sometimes alone, sometimes with a crew, and occasionally with a pilot aboard. It deals exclusively with those aspects of the work which the author has actually touched himself or which he has delegated to some responsible member of his crew. Much of the work on hæmoglobin which has been done at Cambridge has been carried out under the auspices of the Hæmoglobin Committee of the Medical Research Council. To them and to his various pupils and collaborators the author expresses an indebtedness which must surely be fully reciprocated.

Hæmoglobin, as Prof. Barcroft says and demonstrates, is one of the most remarkable, if not the most remarkable, of substances in Nature, and it is little matter for surprise, on comparing the present volume with the previous edition of 1913, to note how greatly our knowledge of this singular compound has been augmented through the activities of the Cambridge laboratories.

We should note perhaps first the investigations by Anson and Mirsky, Robin Hill, Keilin, and others, on the chemical nature and relations of the various porphyrin derivatives. It would take us beyond the scope of a review to enter into these in any detail at all, but one of the most revolutionary points is that hæmochromogen cannot as formerly be regarded as reduced alkaline hæmatin, but must be considered as representative of a large group of loose compounds produced when hæmatin is reduced in the presence of one of a very varied group of nitrogenous substances, mostly bases. Globin, when denatured, can be one of these, but so also may nicotine, pyridine, hyrazine, or ammonia. The resulting hæmochromogens resemble one another very closely, and the one usually prepared from whole blood or hæmoglobin differs from hæmoglobin itself chiefly by containing denatured globin.

Next, the investigation on cytochrome by Keilin, and the probability that cytochrome is a mixture of hæmochromogens which is found very widely if not universally distributed throughout the animal and vegetable kingdom, is fundamental. These researches not merely extend, but also vindicate most thoroughly the investigations of MacMunn on the histohæmatins in 1886, and show that Hoppe-Seyler's criticism of these was mainly unjustified. In fifteen years the opinion with regard to the specificity of hæmoglobins has taken quite definite form. This specificity is probably due for the most part to differences in the protein part of the molecule, though minor and relatively insignificant differences due to differences in the hæmatins cannot be finally excluded.

With regard to the nature of solutions of hæmoglobin and the method of preparing these in a state of reasonable purity, great advances have also been made. The researches of Adair, for example, indicate that the molecular weight of hæmoglobin in solution as determined by its osmotic pressure is of the order of 68,000, which corresponds to four times that expected from the empirical formula, or a value of 4 for n in Hill's equation. The dissociation curve of hæmoglobin and the chemical dynamics of the union of oxygen with hæmoglobin are discussed with great clearness and in considerable detail, and in the course of this we approach a subject which has shown the most remarkable development, namely, a study of the kinetics of the oxygenation and reduction of hæmoglobin and of the formation and dissociation of carboxy-hæmoglobin in the remarkable researches by Hartridge and Roughton. These investigators, by the use of most ingenious methods, have been able to determine the length of time taken for combination between oxygen and hæmoglobin under various conditions. It is interesting to note in passing that the velocity constant for oxygenation of hæmoglobin is about 7·5 times as great as that for the reduction of oxy-hæmoglobin. The high affinity of hæmoglobin for carbon monoxide as compared with oxygen is not due to a high velocity constant for a union between the two, but to the extreme slowness with which the dissociation takes place again, so that where oxy-hæmoglobin would dissociate in a fraction of a second, carboxy-hæmoglobin would require several minutes.

There are many other interesting comparisons between carboxy-hæmoglobin and oxy-hæmoglobin which are discussed. Hæmoglobin, though apparently a very complicated and unstable substance,

can be produced artificially from the proximate constituents, hæmatin and globin. Indeed, many compounds of hæmatin and other metallo-porphyrins with various proteins have been produced by R. Hill. Two interesting substances which are discussed in some detail are chlorocruorin, in which the porphyrin group is different, and hæmocyanin, which is a copper-porphyrin compound.

The various hæmoglobins and other porphyrin derivatives which are scattered so widely throughout the animal kingdom possess those properties best suited to the particular biological conditions under which each of them functions.

The book is of great interest, not merely for the large amount of information contained in it, which would not easily be available from any other source, but also by reason of the interesting method by which the author presents the subject and by the incidental anecdotes freely scattered through its pages. These give that personal touch which is so characteristic and attractive a feature of Prof. Barcroft's writings. It is a book which will be read and re-read. C. L. E.

Toxic Gases and Vapours.

Noxious Gases and the Principles of Respiration influencing their Action. By Yandell Henderson and Howard W. Haggard. (American Chemical Society Monograph Series.) Pp. 220. (New York: The Chemical Catalog Co. Inc., 1927.) 4.50 dollars.

THE authors state that the control of manufacture, handling and sale of substances which are poisonous, other than food and drugs, is inadequately dealt with by the existing Federal and State laws of the United States of America. They have therefore set out in a monograph, which is primarily intended for chemists and engineers, a classification of the noxious gases and volatile substances most frequently met with in industry, with a description of the physiological action of each, so far as it is known, and of the treatment appropriate to counteract its harmful effects on the body.

The first part of the book is devoted to a description of the physiological processes concerned in respiration, to the application of the laws of gases and vapours, and to the principles determining absorption, distribution, and elimination of volatile substances in the human body.

The control of respiration and the respiratory functions of the blood are explained at considerable length, and a reader of this volume will gain a fairly comprehensive view of modern conceptions on these matters.

Toxic gases and vapours are viewed as problems of respiration, and are therefore classified rather from the point of view of their physiological effects than of their chemical relationship. The authors divide them into four groups, namely: (1) Asphyxiants, (2) irritants, (3) volatile drugs and drug-like substances, (4) inorganic and organo-metallic substances. The asphyxiants are subdivided into: (*a*) simple asphyxiants which are physiologically inert and act by excluding oxygen from the lungs; and (*b*) chemical asphyxiants which act either by preventing the blood transporting oxygen or by preventing the tissues from using it.

The irritants are for the most part corrosive agents which injure the tissues of the respiratory tract and thus induce inflammation with a consequent impairment of gaseous exchange in the lungs. Most of the warfare gases fall into this category, but the authors are not concerned with them as such, and they are merely mentioned in their relation to industries.

The volatile drugs and drug-like substances are those which exert some action after absorption through the lungs. They consist of hydrocarbons, many of them anæsthetics, but including also the organic nitro compounds which act upon the blood and circulation, bringing about severe anæmia, and in some cases degeneration of organs such as the liver.

The inorganic and organo-metallic group includes such true poisons as phosphorus, mercury, and lead.

The chief uses in industry and the mode of action on the body and treatment, so far as they are known, are detailed under each group. Reference is also made to recent observations on the relationship between physiological action and chemical constitution, with the deductions which have been drawn therefrom.

The book is written in a very readable style and forms a valuable addition to the literature on the medical aspects of industrial hazards.

As it is intended primarily for engineers and chemists, it perhaps goes into greater detail than is necessary on the mode of action of some of the substances dealt with, for example, in the case of the volatile drugs and drug-like substances.

The authors very rightly emphasise, however, that in accidents from toxic gases in industrial plants, the saving of life is in the hands of the workers present, since in most cases medical aid must inevitably arrive too late.

Our Bookshelf.

Archæology and Ethnography.

The Nile and Egyptian Civilization. By Prof. Alexandre Moret. Translated by M. R. Dobie. (The History of Civilization Series.) Pp. xxix + 497 + 24 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopp, 1927.) 25*s*. net.

In "From Tribe to Empire," Profs. Moret and M. G. Davy drew a picture of the growth of civilisation in the favoured area of the Mediterranean and Near East, taking this to include Mesopotamia. The former now turns to a more intensive study of one of the three great cultures included in the area, namely, that of Egypt. As might be expected from Prof. Moret, the religious aspect is his special preoccupation; but in Egypt that is almost inevitable. For, as he points out, the character of the records from which our knowledge of Egyptian history is drawn, which are almost exclusively of a funerary or dedicatory nature, gives them the peculiarity of recording gratitude either towards god or the king.

Prof. Moret visualises Egyptian history, therefore, very largely in terms of the successive dominant religions. The worship of Ra represents the absolute domination of the king, the worship of Osiris the democratisation of the Empire, after an intermediate oligarchical stage, when the ascendency of the clergy of Heliopolis led to the extension of privilege to the priestly class. In the light of these views, Prof. Moret is able to provide an interpretation of the obscure relations of Hatshpsut and Thothmes II. and Thothmes III., which is at least intelligible and, be it said, more reasonable than any hitherto put forward in view of the character of the latter monarch.

Racial Synthesis in Hindu Culture. By S. V. Viswanatha. (Truber's Oriental Series.) Pp. vii + 234. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 10*s*. 6*d*. net.

This book is interesting as symptomatic of the trend of opinion among certain sections of educated India. Its aim is to smooth away distinctions and to emphasise similarities and assimilations in the numerous elements of which the Indian peoples and Indian cultures are composed. Thus, while one school of students turns from the Indo-Aryan aspect of Indian civilisation to seek for the contribution of non-Aryan peoples, the author of this volume is concerned to show, without disregarding the non-Aryan element, that there has been a fusion which has evolved a type of civilisation common to the whole country sufficient to justify its treatment as a unit in the history of the social and intellectual development of mankind. This involves the assumption of a spirit of conciliation and compromise pervading relations among the various peoples of India. It is scarcely necessary to point out that this view of Indian history involves considerable re-reading of the evidence and a revision of accepted theory which are not likely to prove wholly convincing.

Astronomy.

The Constellations and their History. By the Rev. Charles Whyte. Pp. xii + 284 + 4 plates. (London: Charles Griffin and Co., Ltd., 1928.) 10*s*. 6*d*. net.

The purpose of this book is to give an account of the constellations and stars from primitive times, which will be useful to beginners in astronomy. The first chapter contains a short account of the history of the constellation figures, and a map and description of the appearance of the heavens from the British Isles in each month of the year. This is followed by a section of about sixty pages, containing an account of the apparent motions, distances, and physical characteristics of the stars, and brief paragraphs on the nebulæ and the structure of the universe and evolution of the stars. The remainder of the book consists of descriptions of the various constellations, with historical notes and information concerning the more interesting objects to be observed in them.

The structure of the book is well conceived, and if the material had been satisfactory the book would have occupied a decidedly useful place in astronomical literature. The amateur beginner, especially, would welcome a book of this type. It must be said, however, that in spite of the author's obvious conscientious efforts to perform his task as well and as thoroughly as possible, he has not succeeded in rising to the occasion which he has undoubtedly recognised. The language, dignified rather than inspiring, is not infrequently marred by grammatical errors and looseness or obscurity of phrasing. More serious still is a misleading lack of precision which permeates the whole work and makes it impossible to regard the book as a truly scientific one. Examples might be chosen from any part; it will suffice to mention the section on magnitudes (p. 51) and to quote the following sentence from p. 66: "The whiter a star is the hotter it becomes, while the redder it is the cooler it becomes." Serious inaccuracies are much less numerous than small defects of the kind just referred to, but they can, nevertheless, scarcely be described as rare. Laplace, for example, is credited with supposing that the nebular matter out of which, according to the nebular hypothesis, the solar system developed, was originally "absolutely stationary, and consequently could not revolve on its axis." In spite of much valuable information which the book contains, we cannot recommend it to those for whom a good book of its type would be most useful.

The Fundamentals of Astronomy. By Prof. S. A. Mitchell and Dr. C. G. Abbot. Pp. xi + 307. (London: Chapman and Hall, Ltd., 1927. 15*s*. net.

This book is based on Dr. Abbot's previously published work, "The Earth and the Stars," and its scope and general character are in the main identical with those of its prototype. Large sections of the

earlier work have, in fact, been reproduced, with little or no alteration, so that the new volume is effectively a revised edition of the old. The revision involves a slight rearrangement of the material, with additions and amplifications (including charts showing the brightest stars of the constellations) and a removal of the errors and least satisfactory features of the original.

"The Earth and the Stars" was reviewed in NATURE as an essentially good book, marred by looseness in construction and details of presentation. It is very pleasing to find that the defects have now been almost, if not entirely, eliminated, and we have no hesitation in recommending the present volume as a very valuable addition to the growing mass of astronomical literature. The text is enriched (the authors, with an excess of modesty, say "relieved") by a number of relevant and well-chosen anecdotes which accord well with the general tone of the book. It is to be hoped that it will circulate widely amongst those whose interest in impersonal and super-mundane things is waiting to be aroused.

For the sake of future editions, it may be well to point out the more important of the few errors and defects which have been noticed. It was Newton, and not Fraunhofer, as stated on p. 22, who introduced the slit into spectroscopic work. The diagram on p. 57 is ineffective, because of the small scale on which the earth is drawn. The account, on p. 241, of the process of emission and absorption of light (taken over from the earlier book) is so vague that it is difficult to believe that it would be intelligible to anyone not previously familiar with the Bohr model. The definition of the chromosphere (p. 148) as the whole atmosphere of the sun, including the reversing layer, is discordant with history, etymology, and general usage. Finally, the angstrom is not one ten-millionth of a metre, as stated on p. 221, but one ten-thousand-millionth.

The book is well printed and produced, though it has the excessive weight characteristic of many modern American scientific works. H. D.

Biology.

Shell Life: an Introduction to the British Mollusca. By Edward Step. New and revised edition. Pp. 421 + 32 plates. (London and New York: Frederick Warne and Co., Ltd., 1927.) 7*s*. 6*d*. net.

THE new edition of Mr. Edward Step's "Shell Life" is very attractive with its many delicately coloured plates. It is a popular account of all common mollusca, marine, fresh-water, and land, of Britain, and not only the shells but also the animals are described with notes on their habits. It is admirably fitted for its purpose—to introduce those who have no scientific training to the delights of collecting and observing one of our most interesting groups of animals, but we cannot help wondering whether the author's way of coining popular names whenever possible for even the rarer shells is really the best way. Such names as the 'peppery furrow-shell,' 'Turton's weasel-eye,' 'despised eolis' and 'least whelk,' do not, we think, really appeal to the lay mind more than the scientific names, even though based on these. Moreover, they have no meaning for anyone other than British, whereas to know the scientific name at least puts one in touch with foreign correspondents. However, as the scientific names are always added, this is a small matter.

Of more importance is the fact that *Littorina littorea*, the common periwinkle, is still stated to lay its eggs in a gelatinous mass on seaweed. This statement was fully accepted in 1901, the date of the first edition, but Dr. Tattersall in 1908 read a paper before the British Association showing that our three common periwinkles, *L. littorea*, *L. obtusata*, and *L. rudis*, are all different, *L. littorea* laying single egg capsules capable of floating, shaped like a soldier's tin hat and enclosing one or two, rarely three or four, eggs, which hatched as early veligers, *L. obtusata* laying eggs in a gelatinous mass on sea-weed (similar to Mr. Step's figure which he attributes to *L. littorea*), and *L. rudis* being viviparous.

The author's suggestion that *Solen pellucidus* is very likely only a variety of *S. siliqua* cannot be correct. Study of its life and habits and observations on the young of *S. siliqua* amply prove them to be separate species. With regard to the pteropods, British species are still stated to be rare, although *Limacina retroversa* is taken in enormous numbers in plankton round our coasts, forming a very important fish food; *L. Lesueuri*, which is not mentioned, has also been recorded both for the Channel and the North Sea.

Popular Handbook of Indian Birds. By Hugh Whistler. Pp. xxiv + 438 + 17 plates. (London and Edinburgh: Gurney and Jackson, 1928.) 15*s*. net.

THE present volume has been written by Mr. Whistler, but its issue is due, mainly, to the generosity of Mr. W. S. Millard, assisted by Mr. W. F. Mitchell and Sir George Lowndes, whilst it is due to these gentlemen also that the work is now purchasable at a price so far below its real value.

A book on the common birds of India is one which has for very long been a *desideratum*, and though several authors, amongst others Inglis, Finn, and Dewar, have written accounts of certain classes of birds, there has been no book to which a visitor to India could turn when desirous of ascertaining the names and habits of the birds he sees during the course of his travels in India.

This work very largely meets the needs of the traveller in India, but it certainly caters for the visitor to north-west and western India, rather than for those who may chance to visit other portions of that vast Empire. The author's personal knowledge of birds is obviously confined to the birds of the Punjab and North-West Provinces. So long as he writes about these birds he is able to be both scientifically correct and also very interesting. When, however, he writes about birds from other provinces, which is seldom the case, he has not the same grip of his subject.

Despite the above shortcomings, Mr. Whistler's work is undoubtedly the best and most comprehensive popular work on Indian birds that has yet appeared and should be of the greatest help to anybody who wishes to know more about the common birds he sees every day in India. In his preface, Mr. Whistler gives us his ideas on classification and some other points which are, perhaps, quite unnecessary in a work of this character. On the other hand, his comments on the points on which further information is still desirable are quite good.

The get-up of the book is excellent, and both the colour plates and woodcuts quite up to the high standard of all Mr. Gronvold's work. We regret that the publishers have found it necessary to use such heavily loaded paper, as the weight of the book makes the reading of it to be literally no light task.

Seashore Animals of the Pacific Coast. By Prof. Myrtle Elizabeth Johnson and Harry James Snook. Pp. xv + 659 + 12 plates. (New York: The Macmillan Co., 1927.) 32*s.* net.

THIS book, as the preface tells us, is a non-technical, illustrated account of the structure and habits of the common seashore animals of the west coast of the United States, and it will certainly be a great help to all those interested in shore collecting.

Two things strike the British zoologist about the Pacific fauna: the first is the general similarity to one's own common sea-shore animals, the second the decided differences, for there is really scarcely any common animal of the same species in the two regions. In general agreement are the jelly-fishes, hydroids, starfishes, and sea-urchins, anemones in the rock pools, limpet-like flat mollusks on the rocks, and other gastropods, sand-dwelling bivalves and other numerous sand- and mud-dwellers, but look into these carefully and great differences are seen. There is not one true limpet (*Patella*) mentioned, its place apparently being taken by the more primitive *Acmæa*, and by *Fissurella*, which has its headquarters in those parts; the periwinkles, top-shells, and whelks are all different species, and the same applies to most of the other animals. There are naturally some outstanding differences. A shore characterised by the beautiful 'sea pansy' in the rock pools and by the egg case of *Argonauta* (the Argonaut 'shell') cast up on the beach, is an altogether desirable collecting ground and one looked upon with envy by the Briton who hopes to go there some time.

Altogether an extremely good idea of the shore fauna is given and most of the illustrations are excellent, especially the photographs from life and some outline drawings, such as an atlantid on p. 527 and a diagram of *Tethys* on p. 488. The coloured plates, although giving a good idea of the brilliancy of many of these creatures, are not so well drawn as most of the uncoloured figures.

The authors rightly emphasise the desirability of the living animal being studied and if possible not preserved at all, whilst if aquaria are kept they should have few inhabitants.

A Glossary of Botanic Terms: with their Derivation and Accent. By Dr. Benjamin Daydon Jackson. Fourth edition, revised and enlarged. Pp. xii + 481. (London: Gerald Duckworth and Co., Ltd.; Philadelphia: J. B. Lippincott Co., 1928.) 15*s.* net.

THE late Dr. Daydon Jackson was engaged in the revision of the proofs of this book in its fourth edition at the time of his death. His last contribution to the science that he loved will be of permanent value, and it is to be hoped that in future years some other botanist will continue this valuable work, and that the "Glossary of Botanic Terms" may long be available to smooth the path of the reader who would grapple with the terminology of a very descriptive science.

In the present edition the original pages are reproduced by photo-zincography. There are sixty additional pages of new terms, the results of the sometimes misplaced ingenuity of the botanical writers of the last decade. A list of commonly employed signs and abbreviations follows, and the work terminates with a bibliography of other books of a similar category.

Topographical Anatomy of the Dog. By Dr. O. Charnock Bradley. Second edition. Pp. xii + 268. (London and Edinburgh: Oliver and Boyd, 1928.) 24*s.* net.

PROF. CHARNOCK BRADLEY'S excellent manual, "Notes on the Dissection of the Dog," has now grown into an important treatise on canine anatomy, which is not only of interest and value to the veterinary student and surgeon, but also to medical and science students. It is a valuable work of reference to the comparative anatomist.

Chemistry.

Anorganische Chemie. Von Prof. Dr. Robert Schwarz. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Herausgegeben von Dr. Raphael Ed. Liesegang, Band 16.) Pp. xi + 139. (Dresden und Leipzig: Theodor Steinkopff, 1927.) 8 gold marks.

IN this little work the author has attempted to sketch the most important advances made during the years 1914–25 in inorganic chemistry. Since separate volumes in the series deal with the closely related branches of physical chemistry, physico-chemical mineralogy and petrology, colloidal chemistry and atomic structure, and others are to follow on metallography and inorganic chemical technology, attention has been mainly directed to experimental work on the preparation and properties of the elements and their compounds.

A short introductory section deals with the discovery of new elements by means of X-ray spectra, views on the composition of the earth's interior, molecular structure and its relation to the colour of inorganic substances, and with the classification of metallic hydrides. The elements are then all briefly reviewed in the usual groups, nitrogen, silicon, and sulphur being rather more fully noticed

than any of the others. Thus the complex acids derived from sulphur, and from sulphur and nitrogen, are described, and also the application of Werner's theory to the structure of complex silicates. Many of the common elements, on the other hand, have received very scant attention. The last section of the volume is concerned with the developments arising out of Werner's work on co-ordination compounds of various types.

Selection of the material is necessarily very difficult, and naturally a large amount of attention has been paid to German periodicals, but there are also frequent references to English, American, French, and Italian publications, and the volume will be found to form a readable and useful supplement to the standard text-books.

Reaktionskinetik gasförmiger Systeme. Von C. N. Hinshelwood. Übersetzt und erweitert von Dr. Erich Pietsch und Dr. Gertrud Wilcke. Pp. xii + 246. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 16 gold marks.

English chemists will be glad to see that Mr. C. N. Hinshelwood's admirable book on the "Kinetics of Chemical Change in Gaseous Systems" has now been made available to a larger public by the appearance of a German translation. For the most part this translation follows the English text exactly, but the appendices to the English edition have now, with advantage, been incorporated into the body of the book. Further, the translators, with the consent of the author, have introduced a certain amount of new matter dealing with recently published results, but in doing so have been careful to leave unimpaired the original method of treatment.

The book has been made more valuable by the inclusion of a classified index (thirty-nine pages) of the most important gaseous reactions of which the reaction kinetics have been investigated. Under each reaction an alphabetical list of authors, with references, is given, and there is further a section (thirteen pages) containing references to papers "of general and theoretical importance." This index, evidently the product of much painstaking work, is itself a contribution of no small value to the literature of the subject, deserving the attention of all who are interested in the problems of reaction kinetics.

The format of the German edition, though inferior to that of the original, is not unsatisfactory, and the figures and formulæ are clearly set out. Drs. Pietsch and Wilcke are to be congratulated on the production of a worthy translation of a notable book.

A Text-book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. (Griffin's Scientific Text-books.) Vol. 10: *The Metal-Ammines.* By Miss M. M. J. Sutherland. Pp. xxv + 260. London: Charles Griffin and Co., Ltd., 1928.) 18*s.* net.

The appearance of a separate volume on "The Metal-Ammines," in Friend's "Text-book of Inorganic Chemistry," suggests the prospect of a book of marked individuality, dealing with one of the most exciting sections of modern inorganic chemistry. This prospect has not been realised, since the text of Miss Sutherland's volume contains even less readable matter than the average of this series.

The book contains three introductory chapters, covering about 28 pages, but even these show a singularly poor response to the inherent interest of the subject, and, with the exception of a page on the electronic theory, they might all have been written during the confused pre-War period, when even Werner himself did not appear to be sure whether principal and subsidiary valencies are identical or different. It is indeed almost a *reductio ad absurdum* that the author gives more space to the cyclic formulæ suggested by the editor in 1908 than to the whole of the modern work on valency. The remaining seven-eighths of the book are occupied by a catalogue of ammines arranged according to the periodic classification, but here again the pre-War character of the text is shown by the fact that the index contains no reference to any of the polyammino-compounds described by Pope and Mann in a series of papers from 1924 onwards.

The book can, however, be commended without hesitation as a compendium of the earlier literature, summarised from the view-point of the earlier period, and entirely unspoiled by any electronic heresies.

Engineering.

Engines: a Book founded on a Course of Six Lectures (adapted, in the old phrase, to a Juvenile Auditory) delivered at the Royal Institution of Great Britain. By Dr. E. N. da C. Andrade. Pp. xv + 267 + 36 plates. (London: G. Bell and Sons, Ltd., 1928.) 7*s.* 6*d.* net.

Prof. Andrade's book is founded on the Christmas lectures delivered by him at the Royal Institution last year. Not a little difficult is it for the author of such a work to decide just how far to go in the development of his subject. It is clearly necessary, after the broad principles have been carefully enunciated, to show how they are applied in actual engines, and since they are applied differently in different types of engine, it is obviously necessary to trace the operative principle in each type. This is very effectively done without any suggestion of over-development.

There are one or two misstatements of fact which might be put right in a new issue. For example, it is unfortunate that the impression should be given that practically all marine boilers are of the water-tube type, particularly at a time when attempts are being made to overcome the difficulties associated with the use of water-tube boilers on ships. Again, it is suggested that in a De Laval turbine nozzle the divergence at outlet determines the pressure drop, whereas it is merely provided to improve the efficiency, and the pressure drop is determined by the area of the throats of the nozzles of the successive stages. Nozzles with no divergence at outlet are quite commonly used in pressure compounded impulse turbines for velocities greater than the velocity of sound; in such cases the steam jet diverges after leaving the nozzle.

Most of the great men in engineering are given due credit for their work, but in the turbine section Rateau is surely as much entitled as De Laval and Curtis to be mentioned with Parsons. Yet he is not even referred to; the credit for his work is given to Curtis, and a Curtis-Rateau or pressure compounded impulse turbine is inadvertently described as velocity compounded, whereas this description applies only to the first of its several stages. These, however, are merely the slips which appear to be inevitable, and they do not in any way affect the fundamental facts with which the book sets out to deal. It is an excellent work and should prove a valuable asset to those responsible for the early education of engineers. L. M. D.

Steam Condensing Plant: a Brief Account of the Construction and Principles involved in the Design of Steam Condensing Plant. By John Evans. Pp. xii + 202. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 7*s.* 6*d.* net.

As the sub-title indicates, this book is intended for those "engaged in Installing, Maintaining, or Operating Steam Power Plant," and to such it should prove invaluable. It is of no particular value, except perhaps as a convenient handbook, to the designer or the theorist, and for the purpose for which it is intended this is perhaps its most valuable characteristic. The amount of theory used in the descriptive matter has been kept down to a minimum, consistent with the necessity for the reader to understand the functions and factors which affect condenser performance, and the theoretical explanations given are so lucidly expressed that they are quite easily understood by those unskilled in the technical treatment of engineering problems.

The order of work is well arranged. The functions and desiderata of condensers in general are first dealt with, after which the various types of condenser are classified. The types are then separately treated in detail in their proper order of importance, namely, surface, jet, ejector, and evaporative. This separate treatment is brief but concise and none of the rudiments escape attention, while space is found for some excellent descriptive illustrations and sketches of the commercial products of some of the best manufacturers. In each case the advantages and disadvantages of the type, as compared with the others, are set out clearly, and the general outlines of a design for certain specified conditions are given. A chart showing the maximum economical vacuum for given cooling water conditions, and an investigation of the causes of failure of a condenser to maintain the designed vacuum, are exceedingly useful sections. Air pumps, sometimes erroneously styled auxiliaries to condensers, are very properly treated as fully as condensers themselves, and feed systems, deaerators, etc., and cooling towers, spray ponds, etc., each receive appropriate attention.

For its size the book contains a wonderful lot of useful matter, and there is probably not a single paragraph which could be excised to advantage. L. M.

Practical Radio Telegraphy. By Lieut. Arthur R. Nilson and J. L. Hornung. Pp. ix + 380. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 15*s.* net.

This book is written for radio students who are preparing to become radio operators. Very little knowledge is presupposed and we were impressed with the care the authors take to explain elementary electrical principles, so that when the student comes to radio circuits and apparatus he can readily obtain a good knowledge of how they work. It is a good handbook from which to train elementary students, and should also prove useful to operators who have to work standard American equipments.

Previous to the War it was the custom to use sparks for radiotelegraphic transmission. After the War the trend of design was towards vacuum tube and arc equipments. Hence many of the textbooks written in the early days are of little use to those who have to operate modern equipments. Again, in 1918, when broadcasting began to be considered as a commercial proposition, many books appeared describing receiving and transmitting sets, but entirely neglecting to explain radiotelegraphic apparatus. This book, therefore, will be welcomed by all—and especially by those with scant technical knowledge—who desire to qualify as radio operators.

In arc radio transmission the carbon electrode burns away very slowly, as it burns in a closed chamber containing hydrogen gas. The hydrogen gas for the arc is obtained by the decomposition of alcohol, which is fed into the chamber drop by drop and is vaporised by the intense heat of the arc between the copper and carbon electrodes. In the last chapter a good description is given of the radio compass which enables the navigator to locate the position of radio beacons. Light and sound signals are both very untrustworthy in foggy weather. Had this device been invented fifty years ago, many thousands of lives and millions of pounds would doubtless have been saved by its use.

Geography and Travel.

(1) *India by Air.* By the Rt. Hon. Sir Samuel Hoare. Pp. xix + 156 + 24 plates. (London: Longmans, Green and Co., Ltd., 1927.) 6*s.* 6*d.* net.

(2) *Il mio volo attraverso l' Atlantico e le due Americhe.* Per Francesco de Pinedo. Con un proemio di Gabrielle d' Annunzio. Pp. vi + 27 + 281 + 130 tavole. (Milano: Ulrico Hoepli, 1928.) 48 lire.

(1) Successful long-distance flights are becoming so numerous that the habit of writing a book descriptive of each must soon end. Except for the technical details of flying, there is a great deal of sameness about such books, although the aerial views are always of interest. Five de Havilland aeroplanes were ordered for the new service between

Cairo and Karachi. Sir Samuel Hoare took passage in the first and flew from Croydon *via* Italy, Malta, Tripoli, Egypt, and Basra to Delhi and the north-west frontier, and then back to Egypt. The journey from England to Delhi was 6005 miles and occupied 62¼ flying-hours in eleven days. The book is a bright account of his and Lady Hoare's experiences on a journey which, though mainly uneventful, made history in air communications.

(2) The journey of Col. F. de Pinedo was longer and more eventful than Sir Samuel Hoare's. With two companions he flew from Italy, *via* Morocco and West Africa, across the Atlantic to Brazil and Buenos Aires; thence he crossed the Amazon basin to Para, and *via* Hayti and Cuba reached New Orleans. In Arizona his machine, *Santa Maria*, was accidentally destroyed; but he sent to Italy for a duplicate, and flew from New York *via* New Orleans to Chicago, Quebec, Newfoundland, and then home *via* the Azores and Lisbon. It was a fine achievement, and is described in detail in a beautifully illustrated volume.

The Open-air Guide: for Wayfarers of all kinds. By John R. Ashton and F. Arnold Stocks. Pp. 209. (Manchester and London: John Heywood, Ltd., n.d.) 3*s.* 6*d.* net.

The authors of this pocket volume have gathered into a small compass a great deal of information which should prove of value to boy scouts, girl guides, and other campers and country wanderers. The chapters are suggestive rather than exhaustive, and some compensation for their brevity is to be found in the short bibliographies attached to each. The sections on weather lore, map reading, and the history of roads are among the best. Those on the geological features of scenery and on wild flowers are too condensed to have great value. There are useful sections on camp equipment and on first-aid. Figures of architectural types are well drawn, and there is a folding map showing places in England and Wales held by the National Trust.

The book is a sign of the growing interest in the countryside, not only on the part of motorists but also by walkers and campers. It is to be hoped that this interest will help to guard the scenic beauties of the country from devastation at the hands of builders and road-makers.

Seaways and Sea Trade: being a Maritime Geography of Routes, Ports, Rivers, Canals and Cargoes. By A. C. Hardy. Pp. xi + 240 + 14 plates. (London: George Routledge and Sons, Ltd., 1927.) 15*s.* net.

There is much valuable geographical matter in this book, much that is overlooked in the orthodox volumes on commercial geography, but it is too incomplete to merit its sub-title of a maritime geography. Routes are fairly well treated, and so are canals, but the chapters on cargoes and ports are far from complete. That is a pity, for the author knows his subject and writes in a fresh and interesting style. A book of twice the length would have proved readable even to those who find that commercial geography is generally dull. Every chapter is full of interest and well illustrated. The book treats the geography of trade from an angle that is too often overlooked. It should find a place in all school libraries, where its popularity would be assured.

Geology and Mining.

Clays, their Occurrence, Properties and Uses: with Especial Reference to those of the United States and Canada. By Prof. Heinrich Ries. Third edition, revised and enlarged. Pp. vii + 613. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 35*s.* net.

When a book by an authoritative writer like Prof. Ries reaches its third edition, the task of a reviewer is usually little more than to indicate to what extent it has been brought up-to-date, and what important changes (if any) have been made either in the subject-matter or its treatment.

Some conception of the additions may be gathered from the fact that the first edition, published in 1906, had only xvi + 490 pages against the vii + 613 pages of the present issue (the latter having a contents table of one page preceding the text, instead of the more elaborate contents table, with list of illustrations, etc., of the earlier edition). Moreover, the sections on methods of mining clays and methods of manufacture, occupying 77 pages in first edition, have been omitted, so that the *new* matter in the third edition amounts to about 200 pages as compared with the original issue. The extra material includes a new chapter dealing with Canadian clays, and a section on bentonite, but the main portion results from the embodiment, in the text, of the more important facts accumulated respecting clays within comparatively recent years. Copious references to original sources are distributed through the book.

As might be expected, in dealing with such a vast amount of recent literature, some omissions are discoverable; nevertheless it may safely be said that Prof. Ries has produced a work which will remain the most valuable book of reference on clays generally for years to come. Though American and Canadian clays have received special attention, it should be understood that clays of other countries have been by no means neglected.

Der Bewegungsmechanismus der Erde dargelegt am Bau der irdischen Gebirgssysteme. Von Dr. Rudolf Staub. Pp. viii + 270. (Berlin: Gebrüder Borntraeger, 1928.) 18 gold marks.

This interesting book is a speculative discussion of the causes of motion of the earth's crust, which have led to great foldings and mountain building, and also, according to opinions to-day widely current, to large relative displacements of the continents. The discussion is from a purely geological viewpoint, and is entirely non-mathematical. It would appear from the bibliographical index that the author is not acquainted with so important a work, closely bearing upon his subject, as Jeffreys' recent book, "The Earth." The author's conclusion is that the

two primary causes of relative motion of the earth's outer layers are a tendency of the uppermost layers towards the equator, and of the subcrustal layer to flow polewards; on the second of these he differs from Wegener, who postulated a westerly drift of the continents as the cause co-operating with the drift towards the equator.

Tin Mining: a Complete Guide for all Actively Interested or Engaged in Tin Mining. By C. G. Moor. Pp. xi + 171. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 8*s.* 6*d.* net.

THE sub-title to this book describes it as a complete guide for all actively interested or engaged in tin mining. In the introduction the book is stated to have been designed to help the practical miner and those investing in tin-mining enterprises. Actually, it is a book treating principally of alluvial tin mining and well suited to enlighten the working miner and the layman on the general aspects of that most important branch of tin mining. It is written in a lucid and fluent style; the type is clear and the format of the book is good.

While, therefore, it can be recommended to those desiring to have some broad knowledge of the subject, it is not written for the mining engineer. It includes no mining plans nor lay-out of areas; there are no drawings of dressing machines; the only illustrations in the book are photographs of tin mining in the Straits, and even these are not referred to in the text.

Medical Science.

Food Infections and Food Intoxications. By Prof. Samuel Reed Damon. Pp. viii + 266 + 18 plates. (London: Baillière, Tindall and Cox, 1928.) 18*s.* net.

THE author has divided the contents of this book into sections comprising (1) infections from food, (2) intoxications from food, (3) zoo-parasitic infections acquired through food. The section which deals with food infections includes not only food poisoning due to the Salmonella group of bacteria, but also infections such as *B. tuberculosis*, *B. melitensis* (undulant or Malta fever), *Streptococcus epidemicus* (septic sore throat), and the ray fungus (actinomycosis). This must be regarded as a somewhat arbitrary list, which, if it includes actinomycosis and septic sore throat, might equally well have been extended to include infections by *B. diphtheriæ*, *B. typhosus*, and *B. dysenteriæ*, all of which are in greater or less degree conveyed by food and drink. No mention is made of the possible transmission by milk of the *B. abortus* of cattle and the illness which it causes in man, though the author refers to the close relationship which exists between this organism and the virus of undulant fever, *B. melitensis*.

Under food intoxications, those toxins are described which are associated with *B. botulinus* (botulism), mushrooms, fish (certain organs of certain fish at certain times, and fish that are infected with bacteria pathogenic for man), grain (ergotism and lathyrism), potatoes (the alkaloid, solanin, occasionally present in increased amounts), and milk. This last is an interesting case of intoxication at second hand. It is caused by drinking the milk or eating the flesh of cattle which have themselves been poisoned by feeding on certain poisonous plants, particularly white snakeroot (*Eupatorium urticæfolium*) and rayless golden-rod (*Aplopappus heterophyllus*); it occurs in certain areas of the southern and mid-western States of America, though much less frequently than formerly.

The etiology, symptomatology, diagnosis, treatment, and prophylaxis of each infection or intoxication are described and very useful lists of references appended, though much recent work on the Salmonella group of bacteria has been disregarded.

H. S.

Pharmacognosy and Materia Medica: for Students in Pharmacy and Practising Pharmacists. By Prof. Homer C. Washburn and Walter H. Blome. With a Chapter on Vitamines and one on Insulin by Water Pitz. Pp. xiii + 585. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 25*s.* net.

'MATERIA medica' in the conventional sense in which the term is used in this book, means knowledge of the diagnostic characters of natural drugs of botanical or zoological origin. In these days when the factory has largely replaced the individual craftsman in the art of converting crude natural drugs into medicinal preparations, such knowledge is rarely required in practice, from either the medical man or the pharmacist, and it has been urged that this position should be recognised by appropriate changes in this branch of pharmaceutical education. Moreover, 'Materia medica,' as a subject in a course of pharmaceutical training, still includes many natural drugs, which have, or should have, ceased to interest orthodox medical men, except perhaps as items in the history of medicine, and on this ground also there is room for reform of the kind just indicated.

The book under review is well written on what are now almost classical lines for such literature, but it does show some modernist tendencies. Thus it devotes separate chapters to vitamins and insulin, and though the section on animal drugs includes musk and leeches, it does also deal with antitoxins, epinephrine, and thyroxine. But until educational authorities change their conception of 'Materia medica' to something more akin to the range of chemical and biological materials actually used in medicine to-day, little change can be expected in books of this character. Even now, however, pharmacognosists might impart more living interest to their textbooks by being more critical and more explanatory in regard to the chemistry of natural drugs. In the present instance, for example, the paragraphs headed "Constituents" throughout the book would gain enormously in interest and value by revision and extension by a competent and critically minded chemist.

Ultra-violet Rays in the Treatment and Cure of Disease. By Percy Hall. With introductions by Sir Henry Gauvain and Leonard E. Hill. Third Edition. Pp. xviii + 236. (London: William Heinemann (Medical Books), Ltd., 1927.) 12*s.* 6*d.* net.

Books which are read by medical readers often leave a good deal to be desired when regarded from the scientific point of view, and this is so in the book in question. A large amount of information on the types of lamps suitable for ultra-violet treatment is collected together, but a practitioner wants more than this; he naturally looks for information on the difficult subject of dosage, and the author might well try to give more definite information here.

The author is apparently under the impression that from the tungsten arc, rays are emitted which cannot be detected by any modern spectroscope or other instrument. Few physicists will agree with him, and still less with his assumption that the ultra-violet rays of the fifth octave (beyond the visible) are not less, but more, penetrating than those of the first octave. Perhaps some revision of an assumption contrary to all experimental facts may appear in a book which in many respects serves the purpose for which it has been written.

Elementary Text-book of General Microbology. By Prof. Ward Giltner. Pp xvi + 471. (London: J. and A. Churchill, 1928.) 15*s.* net.

As its title states, this book is devoted to a general discussion of the science which the author curiously renames "Microbology," insisting that this word means "the biology of the small forms of life," whereas "Microbiology," in his opinion, only stands for "small biology"!

Written in a clear and interesting manner, the book deals with the lower forms of life represented by the yeasts, moulds, protozoa, bacteria, and ultramicroscopic viruses, describes their biology, their intentional and unintentional participation in various branches of industry (dairy products, preserved foods, fermentations, etc.), their occurrence and significance in air, water, soil, and sewage, and their association with disease in the animal and plant world.

In no way a textbook for those specialising in any of these subjects, it gives a survey of the whole field in a manner that is readable, complete, and concise. The terminology is that adopted by Bergey and a certain section of American bacteriologists. H. S.

Miscellany.

Inventions and Patents: their Development and Promotion. By Milton Wright. Pp. vii + 225. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 12*s.* 6*d.* net.

From the days of Jabal, Jubal, and Tubal-Cain people have been engaged in producing articles, both useful and ornamental—articles of necessity and luxury; and we are all (with rare exceptions) interested directly and indirectly in inventions, either as inventors or as benefiting by the ingenuity of others. Where the present is in advance of the past is in the protection afforded to those who desire to receive for a period the pecuniary reward attaching to their inventive powers. Naturally, the patent laws of different countries exhibit certain variations, but there is more than a mere family likeness pertaining to them in common. Mr. Milton Wright, in his book on "Inventions and Patents" writes as an American under the U.S.A. law, but his book is both interesting and valuable to citizens of other States. It may be added that one chapter is devoted to the rights as existent in the various countries. He quotes the saying of an inventor, adapted from a dictum of Thomas Edison's, that a successful invention is 2 per cent inspiration and 98 per cent perspiration, which crystallises the view that genius unallied to industry cannot hope to succeed. Of the twenty-three chapters, those containing "Don'ts" and answers to questions are not the least interesting; but from cover to cover the book merits careful reading and a place on one's bookshelf for the purposes of handy reference. P. L. M.

The Romance of English Trading. By S. A. Williams. Pp. 211. (London: University of London Press, Ltd., 1928.) 2*s.* 9*d.*

This volume tells how the people of Great Britain, from the Middle Ages to the present day, have obtained the necessaries of life. Chapters are devoted to fairs and markets; the rise of sea-trading; the great trading companies; roads and canals; and trading in the railway age. The text affords evidence of wide and recent reading, careful sifting of what has been gleaned, and attractive presentation of the subject-matter. The illustrations are well chosen. The author is the principal of a day continuation school, but the book will appeal to a wider public than that for which it was obviously written.

In a new edition it might be emphasised that the right to hold a market was a privilege obtained from an overlord and jealously guarded. More stress might be laid on the gild system and the fact that the merchant gild antedated the craft gild. The constitution of the joint-stock company of the eighteenth century as compared with that of to-day should be made clearer. The very small tonnage of early merchant vessels is not brought out as it should be. H. W. D.

Pioneers of Invention. By William and Stella Nida. (Harrap's Readers of To-day.) Pp. 189. (London, Bombay, and Sydney: George G. Harrap and Co., Ltd., 1927.) 1*s.* 6*d.*

The attempt to cover the story of invention in applied science, as is done in this volume, within the compass of 188 pages, is almost bound to fail, unless made by one who is expert in each separate invention. The severe condensation necessary leads either to a bald catalogue of facts or, if the attempt is made to be interesting, then to generalisations that are too sweeping, or to emphasis on the striking rather than the important, or even to statements that are actually misleading. As an

example, we may cite the generalisation on p. 57, in speaking of Eli Whitney: "Standing behind every inventor we find a benefactor who, with friendship or money, has helped him to succeed." A misleading statement is that on p. 44, to the effect that George Stephenson built *Puffing Billy*. Success or failure of an invention turns frequently on small practical difficulties, and it is too much to expect that a single author can be cognisant of all these minutiæ. H. W. D.

Psychology.

Common Principles in Psychology and Physiology. By Dr. John T. MacCurdy. (The Cambridge Psychological Library.) Pp. xvii + 284. (Cambridge: At the University Press, 1928.) 15*s*. net.

This book is a striking addition to the 'worth-while' books on the functions of the nervous system. It is, however, a difficult book to read, as the author quite candidly admits in his preface. The dominant theme of patterns is purely an abstraction and is an attempt to bring the material and the immaterial more into harmony with one another than is commonly done. Dr. MacCurdy confesses to being averse to materialistic hypotheses and takes up a position which is whole-heartedly immaterialistic. His theory is that all the processes of the mind, and indeed of the nervous system, are integrated, correlated, and controlled by what he calls 'patterns.'

The book is divided into two parts, the first dealing with psychology, the second with the physiology of the nervous system. At the end of each part is a summary of the application of the theory of patterns to these two branches of knowledge. Several of the chapters on psychology into which the author interweaves considerable portions of his very wide knowledge of abnormal psychology are extremely interesting and well-thought-out discussions—apart from any question of patterns. Altogether, an excellent presentation of a difficult subject and a book which requires to be read several times before the author's ideas can be adequately understood.

The Opposite Sexes: a Study of Woman's Natural and Cultural History. By Dr. Adolf Heilborn. Translated from the German by J. E. Pryde-Hughes. Pp. viii + 152 + 5 plates. (London: Methuen and Co., Ltd., 1927.) 6*s*. net.

The author deals with the whole question of woman in three chapters, of which the first covers physical differences and the second the mental differences between the sexes. Current views are ably summarised. While accepting the position of the fundamental and absolute distinction of the two sexes and stating fairly the arguments for assigning woman an inferior or a superior position in the evolutionary scale, the author himself inclines to the former view. This comes out when he considers the development of the social position of woman. A concise historical survey, starting from the functional activities, pictures her social and economic progress as a gradual shackling of man, culminating in the 'feminism up-to-date' which has followed the War, in which, without stressing the point, he hints there is a message. The book, however, is written without bias as to fact and might serve either side of the argument.

A Synthetic Psychology: or Evolution as a Psychological Phenomenon. By Percy Griffith. Pp. xii + 214. (London: John Bale, Sons and Danielsson, Ltd., 1927.) 7*s*. 6*d*. net.

For an author to have to ask for faith, tolerance, and patience is in itself a warning of trouble to come. To claim ignorance of psychology as a passport to success in writing about it even as an amateur is giving the show away. To say that every mother can claim to know more about the psychology of children than all the psychologists put together is decidedly unreasonable. The author's hypothesis of 'mind in general,' which he splits up into 'mind-in-nature' and the 'mind of man,' must surely be held to be not proven.

Intelligence and Mental Growth. By Claude A. Claremont. (Psyche Miniatures, General Series, No. 13.) Pp. 138. (London: Kegan Paul and Co., Ltd., 1927.) 2*s*. 6*d*. net.

The author has presented us with a very readable little book. He perhaps tries to make the subject of intelligence rather simpler than current opinion would justify. Intelligence is defined as the "power to become aware of the necessity of certain causal relationship." Whether the awareness of causation is exactly the same as intelligence is a matter of argument. However, Mr. Claremont is to be congratulated on a very refreshing presentation.

Psycho-Analysis for All: a Lecture delivered in Vienna. By Dr. Rudolf Urbantschitsch. Translated by Dr. Arnold Eiloart. Pp. 63. (London: The C. W. Daniel Co., 1928.) 2*s*. 6*d*. net.

A simple and very abbreviated account of psycho-analysis for the man in the street. The author gives a few illustrative cases, but does not go into any detail of theory. It will probably not convince the reader, but will make him want to know more of the rationale of the method.

Technology.

Grammar of Textile Design. By H. Nisbet. Third edition, revised and enlarged. Pp. xi + 553. (London: Ernest Benn, Ltd., 1927.) 32*s*. 6*d*. net.

This treatise is a standard work on woven fabric construction, and deals mainly with the technical part of textile design. The third edition contains a useful chapter on the decorative value of artificial silk, and the chapter on gauze and leno weaving has been augmented by descriptions and diagrams of American types of flat steel doups for heald and Jacquard harnesses.

Woven fabrics may be divided into three broad divisions: (*a*) fabrics constructed from some simple form of interlacing of the two sets of threads, *i.e.* warp and weft; (*b*) fabrics that have a foundation texture, but on one or both sides the surface is covered with loops or tufts—these are known

as pile fabrics; (*c*) fabrics constructed by cross-weaving, that is, when the warp threads pass wholly or partially round each other, and thereby causing distortion and, in most cases, producing textures that are of an open character. The first 120 pages give all the standard forms of interlacings that are used for weaving the common classes of fabrics. Designs and photographs well illustrate the characteristics of each texture. The chapters on fustian and terry fabrics are very good, and these are typical pile fabrics. Unfortunately, structures for the pile fabrics produced with the aid of wires are not included.

An excellent chapter of 100 pages explains the principles of cross-weaving. These gauze and leno fabrics are not made in large quantities for the home trade; the cellular shirting is a simple type of this kind of cloth. The following chapters deal with specialised structures; for example, tissue, lappet and swivel, single and extra warp and weft figured brocades, damasks single and compound. Very good explanations are given in other chapters of the principal types of quilting fabrics, piqués, and matelasses, and the loom equipment required.

In another chapter descriptions are given of the tapestry styles: some of these structures are complicated, but they are developments of the simpler types. The last part of the book deals with the decorative value of artificial silk, and its reactions with dyes, and also comparisons with real silk. Practically every kind of structure is explained in this book, and it can be recommended to all those who desire to obtain a thorough understanding of fabric construction. J. M. E.

Defects in Glass. By Dr. C. J. Peddle. Pp. x + 205 + xiv + 17. (London: Glass Publications, Ltd., 1927). 8*s.* 6*d.*

In the old days the manufacturers of glass ranked among the most secretive in the whole range of industry. Recipes and processes were jealously guarded, and there was no attempt at interchange of views with regard to the common difficulties experienced more or less by all in the course of the manufacture. The exigencies of the War period brought about a salutary change in the outlook. The value of scientific investigation found recognition, and the inception of the Department of Glass Technology at the University of Sheffield resulted in the establishment of a permanent centre for research work on glass, whilst the formation of the Society of Glass Technology provided for the publication of valuable reports on original work.

The author of this book on defects in glass took a prominent part in glass research, both in the laboratory and in the factory, and his wide experience gives him exceptional qualifications for preparing such a work. The various defects are discussed in detail—more especially devitrification, but also bubbles, seeds, stones, etc.—and not only are the causes clearly explained, and suitable remedies suggested, but how to avoid the troubles is also pointed out.

The glass industry is fortunate in having at its disposal such reliable practical information supplied by an acknowledged authority. All connected with the manufacture of glass should find something of value and interest in the volume, and even users of glass would learn from it many important facts.

Cotton Spinning. By Thomas Thornley. (Intermediate or Grade II.) Fourth edition, revised and very greatly enlarged. Pp. ix + 502. (London: Ernest Benn, Ltd., 1926.) 25*s.* net.

The publication of this, the fourth edition of a work which has for twenty-five years received recognition as a standard treatise on cotton spinning, reveals a further revision and enlargement; the subject matter having been brought up-to-date in conformity with "Cotton Spinning: Elementary" and advanced "Cotton Spinning," which form parts of the same series.

The preparation of this treatise has been effected with the view of assisting all persons who, actively or otherwise, are engaged in the many branches of the spinning industry, and in this object the author must derive no small measure of success. The twelve chapters comprising the book contain some very interesting and practical information on all spinning processes, although a more definite sequence and manner of presentation in dealing with any one particular stage of treatment could be adopted with benefit to the general reader and student. Some of the subject matter, especially in Chapters ii., xi., and xii., could advantageously be omitted in favour of a more extensive treatment of other sections, notably those embodied in Chapters iii. and iv. The illustration of the text is well effected, whilst the miscellaneous calculations and data must prove of guidance to the student. In its present form, the volume is an excellent source of information in the field of cotton spinning, and should be found of valuable assistance. H. S.

Ceramic Tests and Calculations. By Prof. A. I. Andrews. Pp. viii + 172. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.)

This book contains carefully drawn up instructions for preparing test pieces, and for making the various tests, besides showing clearly how to proceed with the necessary calculations. Tests are given for raw materials, fired ceramic products, glazes, frits, enamels, and glasses. Apart from a very few rather loose statements—fortunately of minor importance—the explanations are clear, though generally brief; and the diligent student who makes good use of the examples given for exercise should find himself adequately equipped for dealing readily with most ceramic industrial problems involving calculations.

An appendix, comprising a number of useful tables to facilitate calculations, is followed by a good index. The book is well got up, and misprints are few and of little importance. American standards and tests are used exclusively. Some of these differ from those in general use in England, but anyone who understands either should find no difficulty in applying the other.

Forthcoming Books of Science.

Agriculture, Forestry, and Horticulture.

Edward Arnold and Co.—The Unconventional Garden, Sir Arthur F. Hort, Bart. *Ernest Benn, Ltd.*—The English Grass Orchard, A. H. Hoare. *Chapman and Hall, Ltd.*—Feeding Stuffs, A. S. Carlos. *J. B. Lippincott Company.*—Farm Crop Enterprises, including Soil Management, edited by Dr. K. C. Davis; Southern Field Crop Enterprises, including Soil Management, edited by Dr. K. C. Davis; Livestock Enterprises, edited by Dr. K. C. Davis. *Macmillan and Co., Ltd.*—Text-Book of Tropical Agriculture, Sir H. A. A. Nicholls, new edition, revised by J. H. Holland. *Oliver and Boyd.*—Agriculture, The Science and Practice of British Farming, Prof. J. A. S. Watson and J. A. More, new edition. *Oxford University Press.*—A Tour in Australia and New Zealand: Grass Land and Other Studies, Prof. R. G. Stapledon; Grass Farming in the Welland Valley: a Survey, J. Ll. Davies; Agriculture and the Law of Diminishing Returns, G. Frecheville; A Survey of Milk Marketing: based on Conditions in Wiltshire and Somerset and the City of Bristol, June 1927, F. J. Prewett.

Anthropology and Archæology.

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was staged. Nobile had disappeared in the Arctic and half the governments of Europe were sending ships, ice-breakers, and aircraft to aid in the search for him. Amundsen believed that Italians had treated him badly in the past, but the inherent greatness of the old idealist blazed out once more and he volunteered to lead a search party. On June 18 he left Norway in the large French Latham sea-plane piloted by Capt. Guilbaud, and manned by a crew of four. They disappeared to the northward; wireless signals ceased after a few hours, and only the discovery of one of the floats of the machine off the Lofotens points to the way in which this great Norseman met his end sweeping out on his last voyage like a dead sea-king of old in his funeral ship.

By his great two feats of navigating the North-West Passage and reaching the South Pole, Amundsen had brought himself into the front rank of explorers, and his books on these expeditions must remain classics. Through his last book, "My Life as an Explorer," we are admitted to a more intimate acquaintance than has been possible in the case of other explorers; but any glimpse of human weakness he gave in its pages must not be allowed to dim the greatness of his supreme foresight, fortitude, and success in discovery.

Hugh Robert Mill.

Dr. Robert Knox.

We deeply regret to record the death of Dr. Robert Knox on Sept. 21, at sixty years of age. Knox was born at Leith, and obtained his medical education at Edinburgh and Guy's Hospital. After a short period of work in general practice he became definitely associated with the very young subject of medical radiology, and throughout the rest of his life we may say that he was linked with every important movement in this branch of medicine. With characteristic thoroughness his interests extended to every ramification of the subject; whether it was a question of hospital equipment or the association of the laboratory with clinical work or the status of radiologists, Knox would be found on the appointed committee, and he would be there in committee as member, secretary, or chairman. This went on for years, and until quite recently he appeared to carry the load lightly.

The societies and associations with which Knox worked, and by which his services were recognised in many very pleasant ways, were many. As secretary and then president of the Röntgen Society, he did splendid service during difficult years, and he finally supported its affiliation with the British Institute of Radiology, an institution he also helped to found.

Knox held important positions in the hospital world; he was at one time honorary radiologist to King's College Hospital, the Great Northern Central Hospital, Queen Alexandra Hospital, Millbank, and the Cancer Hospital, Fulham. It was at Fulham that his most important contributions to medical radiology were made. In radio-diagnosis Knox had a great eye to technique, and contributed much to the development of serial radiography and its application to the study of in action; in radio-therapy he cautiously felt his way over many years in the treatment of cancer by X-rays, and, realising the danger of heavy doses to the skin in administering doses to the deeper structures of the body, he devised a method of rotational focus by which this danger was largely eliminated.

In view of the many other claims upon his time, Knox's writings were considerable; his book, "Radiography, X-ray Therapeutics, and Radium Therapy," appeared in 1915, and a second edition was quickly demanded, which led him to divide the book into two volumes, and this is now in its fourth edition.

Knox was well known and honoured in the radiological world; the American Röntgen Ray Society and the Scandinavian Röntgen Ray Society both elected him to their lists of honorary members. On the retirement of the late Dr. Deane Butcher, he became the joint editor of the *Archives of Radiology*, the name of which was years later changed to the *British Journal of Radiology*. His editorial colleagues will always remember how much Knox did for the old *Archives*. He won his way by sheer merit, and he was a man very much liked by his associates. Voluntary workers were always to be found in his hospital departments, attracted by the encouragement he gave them and by a friendship they rightly valued.

S. Russ.

The sudden death of Dr. Stephanos Xanthoudides, announced in the *Times* of Sept. 21 by Sir Arthur Evans, is a blow to the archæologists not only of Greece but also of the whole world, who are indebted to him for his exertions in conjunction with Dr. Hatzidakis in instituting the Museum of Cretan Antiquities. It was outside this museum, according to Sir Arthur Evans's information, that his death took place. Although the museum at Candia represents his life work, he himself was an explorer and excavator of no mean achievement. His work on the vaulted tombs of Mesara in the south of Crete was an illuminating contribution to the history of the early culture of the island. He had also devoted himself to the exploration of its later history, and was an authority on its remains of the Byzantine Age. It is satisfactory to know that he had completed the reparation of the damage to the museum caused by the disastrous earthquake of 1926. His death will be a great loss to his many friends and fellow-workers of all nationalities.

We regret to announce the following deaths:

Prof. D. Noël Paton, F.R.S., until recently Regius professor of physiology in the University of Glasgow, on Sept. 30, aged seventy years.

Sir Henry Wickham, who succeeded in obtaining seeds of *Hevea* from the Upper Amazon which were successfully grown at Kew and distributed in the East, thus starting the plantation rubber industry, on Sept. 27, aged eighty-three years.

News and Views.

A special general meeting of members of the Royal Institution will be held on Monday next, Oct. 8, when the managers will place before them several matters relating to the general position of the Institution and desirable alterations in the structure. The lecture theatre is now much out-of-date, partly on account of natural deterioration, but more particularly through the rise of the accepted standard. Considerable changes must be made in the structure, the seating, and the exits if they are to conform to the requirements which are now usual and are indeed enforced in the case of public buildings. A large sum of money would be required to carry out the re-arrangements and additions under consideration. The expense is not lessened by the determination, which the managers consider to be of the highest importance, that the historic rooms shall not be touched. The sum required is in the neighbourhood of £75,000. At the meeting on Oct. 8, the managers will ask for powers to proceed with negotiations and the preparation of detailed plans. These matters will be submitted for approval or rejection at a further meeting of members in November. There is, of course, the hope that by that time some friend of the Institution may have come forward to save the necessity for disposing on lease of any part of the building.

An observatory is being erected in Mill Hill Park to house the 24-in. reflecting telescope by Grubb which belonged to the late Mr. W. E. Wilson, F.R.S., of Darramona, Ireland, and was presented by his son to the University of London on condition that it should be adequately housed and maintained. The Hendon Urban District Council has provided the site, and provision will be made for the ratepayers to visit the observatory. Provision will be made at the new observatory for the accommodation of the 10-ft. Rowland grating at University College and a cœlostat by Cooke. A well-equipped workshop will be provided and a full-time mechanic appointed so that research apparatus may be made as required, and it is hoped that inventing and trying out new or improved observational methods will constitute one of the chief activities of the observatory. There are, however, several problems relating to the photography of nebulæ for which this instrument appears to be well adapted, such as making short exposures on nuclei of suitable non-galactic nebulæ in order to determine their precise positions relative to the stars, so that data may eventually be available concerning the possible rotation of the galaxy.

George Baxter was born at Lewes in 1804, and as a youth was engaged in the printing works of his father, John Baxter, as lithographer and engraver. At that time prints were sometimes coloured by printing, but the process cannot have been very successful though it had been practised for many years, for even large editions were being coloured by hand. In 1835 Baxter was granted his patent and says: "In order to produce a number of ornamental prints resembling a highly coloured painting, whether in oil or water colours, according to my inventions, I proceed first to have the design engraved on a copper or steel plate." This engraved plate gave the outline and the detail, and colours, chiefly (or only) in oil, were then applied by means of blocks. But the beauty of the prints, which are noted for their delicacy and brilliance, was not entirely due to the method. Baxter was an artist who could paint pictures; he was a practical printer and engraver; he knew what was wanted and had the skill and perseverance to get it. The famous print of Queen Victoria's coronation, for example, contains about 200 portraits, many made from the life by Baxter himself, and needed more than twenty printings to get the colouring.

The first books that Baxter illustrated were printed in 1834, when he resided in King Square, Goswell Road. In the following year he removed to 3 Charterhouse Square, and after nine years (1844) to 11 Northampton Square. His business prospered so that in 1851 he occupied No. 12 as well, and it was in these two houses that the bulk of the work by which he is known was done. His effects were sold by auction in 1860, and in 1867 he died. It seems rather strange that the London County Council, after consideration, concluded that so notable a pioneer and producer of printed colour pictures as George Baxter "was not of sufficient eminence" to justify marking with a memorial tablet the house in Northampton Square where he lived and worked, but it is satisfactory that Mr. E. Kilburn Scott and numerous subscribers have provided and fixed the tablet that was recently unveiled.

Lord Eustace Percy, the Minister of Education, on Wednesday, Sept. 26, opened the new Hastings Museum, which was a palatial residence built by a private resident, Mrs. Kidd, and sold very cheaply to the town by the owner. The configuration of the rooms lends itself to the display of objects illustrating the history of the town and East Sussex. Lord Eustace said that the value of museums, like the one at Hastings, the real significance of which people often forget, is that they are a sort of local visualised reference library of the arts and sciences, and therefore an essential part of national education. Museums represent something like a local college of learning to which the elementary and secondary school children may resort, so that study of the contents may lead to the realisation of the value of education throughout life. In fact a museum ought to be a centre of higher education and intellectual life. Dr. Bather, lately of the British Museum (Department of Geology), who was representing the Museums Association, put in a serious plea for the exhibition, not merely of antiquities, but of what people called 'bygone days.'

Our note on St. Fiacre (see "Calendar of Customs and Festivals," Nature, Sept. 1, p. 334) has stimulated Mr. G. M. Fraser, of the Public Library, Aberdeen, to contribute to the *Aberdeen Press and Journal* of Sept. 21 a well-informed article on this saint who, under

the form of St. Fittack, is the patron of the church of the parish of Nigg, Aberdeen. Mr. Fraser is convinced of the Scottish origin of the saint, accepting Dunstaffnage on the coast of Argyll as his birthplace, at about the end of the sixth century. It is possible that this is correct, as this was an ancient royal seat, and after St. Fittack had settled in France he is said to have been visited by a deputation of chiefs and priests who wished him to accept the throne as a member of the royal line. The question is obscure, and it has to be remembered that in early records 'Scot' is usually to be taken to mean racially what we would now call Irish. Mr. Fraser points out that the various forms of the saint's name, which are many, are all derived from the Irish *fiach*, a raven. How the church at Nigg came to be dedicated to St. Fiacre is not clear, but Mr. Fraser suggests that his patronage of stocking-knitters is derived from his connexion with Aberdeen, as the art is said to have been introduced into France from Scotland. Owing to limitation of space our Calendar must necessarily pass over much that is worth noting. The life of St. Fiacre, apart from the association of his name with a Parisian public vehicle, has many points of interest to the folklorist, such as, for example, the recurrence in his relations with the Bishop of Meaux, *inter alia*, of the familiar story of a grant of such an amount of land as could be encompassed in a day, in which, once more, the beneficiary got the better of the bargain.

A SHORT account of personal recollections of Sir Richard Owen in the later years of his life appears in the *Victorian Naturalist* for July. The writer, Edward A. Vidler, a grandson of Dr. George Bennett, the Sydney naturalist, was then in his early twenties and paid regular visits in the middle 'eighties to Sheen Lodge, a comfortable and picturesque cottage in Richmond Park, where Sir Richard lived with his daughter-in-law and a maid-servant. Richard Owen, then about eighty years of age, is pictured as a man tall and thin, with big hands and feet, square shoulders, a large head, with a very prominent high forehead and very deep-set grey eyes, high cheek-bones, a long heavy nose with broad nostrils, very wide thin-lipped mouth, square chin, over which grew a long beard of black hairs so sparse that the contour of the chin was clearly visible, and long, thin, straight dark hair surmounted by a black skull-cap. He was, to the young man, a fearsome figure at first sight, but had an air of friendliness and gentleness the very antithesis of his outward appearance. Mr. Vidler's anecdotes of Sir Richard reveal him as the great investigator, sure of his ground, as a collector who showed with pride the gems of his collection, and as the possessor of that heavy type of humour which seems somehow to be characteristic of the man of science, though it is scarcely likely that even under its prompting the anatomist would hand his guest the vertebra of a whale in lieu of bread. The disc-like epiphysis alone would represent a mighty pancake! The photograph from the Vidler family album, reproduced in the short article, is an excellent and characteristic portrait of Richard Owen.

ZOOLOGISTS lament, and with some reason, the burden of scientific synonyms which gathers about certain well-known species. But scientific synonymy must take second place to the superfluities of popular nomenclature. Albert Wade has collected the local and general names which have been applied to salmon and sea-trout, and they number one hundred and thirty-six (*Salmon and Trout Magazine*). Even allowing that there are six well-defined life-stages in the history of a salmon, the superfluity is obvious. The great difference between scientific and popular synonymy, however, is that while the former represents some sort of imperfect identification, the latter generally stands for local idiosyncrasy. The list therefore would have been much increased in value had the author indicated the area in which each name was in common use.

THE new geyser which began erupting in Yellowstone Park early in August is described in a recent *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., to be the greatest now active in the world, and with the exception of Old Excelsior, extinct since 1888, the greatest ever witnessed. The crater is elliptical in outline, 100 by 120 feet, and about 8 feet deep. The geyser suddenly bursts forth in furious and explosive activity, hurling water in all directions to an average height of 60 to 75 feet, with occasional spurts reaching as much as 100 feet. Outbursts occur at 15 or 20 sec. intervals, and continue for some three hours before the eruption abruptly comes to an end. Then follow nine hours or so of quiescence, during which the crater is dry except in a small fissure and several boiling mud-springs along the north edge. The action of the geyser is so violent, its eruptions so spectacular, and its periodicity so regular, that it is likely to become one of the Yellowstone's greatest attractions. A special road is now being constructed to make it accessible to the touring public. Of particular interest is the news that Dr. A. L. Day and Dr. E. T. Allen, of the Geophysical Laboratory at Washington, are conducting a thorough investigation of the phenomena. The former eruptions of the neighbouring Excelsior Geyser were not so frequent as those of the new geyser, and lasted only half an hour instead of three hours, but they were even more violent, throwing large masses of water from 100 to 200 feet in the air. In the late 'eighties the steam explosions so increased in power that the sinter encrusting the crater began to be torn off in jagged blocks. The geyser rapidly "erupted itself to death," and for nearly forty years its precipitous-sided pit has been occupied only by a hot seething lake.

THE Fabian Society announces a course of six lectures under the general title "Western Civilisation: whither is it going?" to be given in the Kingsway Hall at 8.30 P.M. on successive Thursdays, commencing Oct. 18. The lecturers and the special aspects of the subject with which each will deal are the Hon. Bertrand Russell (general); Mr. J. B. S. Haldane (science); Prof. C. Delisle Burns (labour); Prof. Ernest Barker (spiritual authority); Miss Rebecca

West (woman); Mr. Bernard Shaw (the future). Mr. Russell's syllabus opens with the provocative statements that western civilisation derives from four sources, Greeks, Jews, Romans, and science, and that the catholic church is a synthesis of the first three. In Mr. Haldane's view, western civilisation rests on applied science, and its future will depend largely on how science is applied to human life; and he will deal specially with socialists' 'reaction' to this thesis. Light on this question will also be thrown by Prof. Delisle Burns, who makes the reassuring announcement that "the contrast between an 'intelligentsia' incompetent with his hands, and 'labour' incompetent with its brain, is breaking down." Miss West will develop her view that the common lot of woman is persecution—in some parts of western civilisation by overwork, in the United States by underwork. Finally, Mr. Shaw, who will lecture last, will begin at the beginning by discussing the thesis that there is an entity to which the term 'western civilisation' can be applied. "To call these bungaloid promiscuities civilisations merely because they have all ceased to run out excitedly to look up at aeroplanes, and can argue about birth-control, is absurd."

Steady progress is being made by the Imperial Geophysical Experimental Survey which is at work in Australia under an arrangement between the Empire Marketing Board and the Commonwealth Government. Mr. A. Broughton Edge, the leader, has visited several areas which, for various reasons, seemed likely to be suitable for the projected tests of geophysical methods. On his recommendation the executive body in control of the survey has authorised a commencement of work by the electrical methods at Anembo, an unworked metalliferous field about 30 miles from Queanbeyan, a town in New South Wales on the boundary of the Federal Capital Territory. The New South Wales Department of Mines has undertaken to test the conclusions of the survey by boring, if they appear to be sufficiently encouraging. In addition, gravimetric work has begun on a brown coal area near Gelliondale, in Gippsland, Victoria, which affords opportunity for useful examination of suspected faulting, while being, at the same time, suitable for certain necessary preliminary studies of the gravity balance under characteristic Australian field conditions. With the arrival of the deputy-leader, Dr. E. Bieler, of McGill University, Canada, in July, and the appointment of several Australians to junior positions, the personnel of the party is now nearly complete.

It is not a simple matter to find mining fields ideally suitable for geophysical tests of the type desired. In most of the known fields the existing shafts, plant, railway lines, etc., introduce complications which it would be well to avoid in test experiments. Over immense areas the existence of underground saline waters, containing from one to five ounces of salts to the gallon, introduces a further difficulty that is rather typically Australian. Even more typical and likely at times to be somewhat annoying to workers on electrical conductivity is the common long rabbit-proof fence of wire netting, the bottom of which goes at least six inches into the ground. Attention is being given to the possibility of effectively applying geophysical methods to the discovery of underground water in a wide area of several million acres in the southern portion of Western Australia. This region is under consideration as one suitable for development under the migration agreement between Britain and the Commonwealth.

At the time of the establishment of the Austrian Republic, although its area and population were each approximately one-quarter that of the old Empire, yet the home supply of coal was almost negligibly small. It was compelled, therefore, by sheer necessity, to develop as quickly as possible the water power that remained to the Republic. Luckily there were many Alpine lakes at a very high level which in 1918 had practically been unused for power purposes. With the help of about 30 per cent of the total capital required from foreign sources, building operations on at least 120 water-power stations have been begun since the War. The installed horse-power is now nearly a million, of which about two-thirds is in operation. The federated railways have four large hydro-electric stations which supply the western main lines. Upper Austria sends its surplus power to Vienna. Similarly Salsburg sends power to Bavaria. The new 220,000 volt line leading from the Alps to the Rheinische-Westphalia industrial districts has brought the question of the export of power to Germany more to the foreground. The possibility is thus opened up of transmitting power to the States to the north of Austria. One advantage of exporting power is that this is one of the few exports which is not burdened by those import duties generally imposed upon raw materials. About two-thirds of the total electric power used for industrial power purposes in Austria is obtained from water power. The Vienna electricity works have more than doubled their output since 1919. The Austrian banks have taken a very active part in developing the power which its mountain lakes and rivers have bestowed on the republic. Further particulars of Austria's water power are given in the *Electrical Times* for Sept. 20.

Mr. Matthew W. Stirling has been appointed chief of the Bureau of American Ethnology, Smithsonian Institution, Washington, D.C., in succession to Dr. J. Walter Fewkes, who retired early this year.

On the retirement of Major Leonard Darwin from the office of president of the Eugenics Society, the fellows and members are presenting him with a portrait. The presentation will take place in the rooms of the Linnean Society, Burlington House, W.1, on Wednesday, Oct. 10, at 5.30 P.M.

The autumn meeting of the South-Eastern Union of Scientific Societies will be held on Saturday, Oct. 27, when visits will be paid to the Croydon Aerodrome

-nd Air-Port and to Whitgift's Hospital, Croydon. articulars can be obtained from Mr. E. A. Martin, Croham Hyrst," St. Lawrence, Isle of Wight, or Ir. R. W. Strickland, 5 and 6 Clement's Inn, V.C.2.

AN unusually extensive edition of the old-fashioned ravelling menagerie is being put on the road by hapman's, the well-known animal dealers of Tottenam Court Road, London, W.C.1. Its extent is ndicated by its major attractions, which include 14 ons, 12 tigers, 10 zebras, 10 polar bears, 8 other ears, 7 leopards, and 200 'various species,' which we nagine means *specimens*, of monkeys, as well as many sser mammals and interesting birds. Beginning on ept. 24 at Chelmsford, the route traverses the midunds of England, and ends with a month's exhibition n Glasgow in December and January. The passing f this large collection should afford an opportunity or many who are out of touch with the larger zoogical gardens to see a good selection of the interesting reatures of other lands.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A resident haplain and lecturer in mathematics; or a resident ecturer in mathematics and physics at the York C. of E. Training College for Schoolmasters—The Principal, St. John's College, York (Oct. 14). A research assistant, under the Safety in Mines Research Board, for vork in connexion with wire ropes used in coal mines—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Oct. 15). A head of the Engineering Department and assistant headmaster of the Junior Technical School of the Darlington Technical College—The Chief Education Officer, Education Office, Darlington (Oct. 18). A senior chemistry master at the Hull Grammar School—The Headmaster, Grammar School, Hull (Oct. 20). A principal of the Denbighshire Technical Institute—The Secretary and Director of Education, Education Offices, Ruthin (Oct. 29). A professor of pathology in the University of Otago, Dunedin —The High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 31). A lecturer in metallurgy at the Birmingham Central Technical College—The Principal, Central Technical College, Suffolk Street, Birmingham (Nov. 3). An analyst at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Salop. A senior mathematical mistress at the Cheltenham Ladies' College—The Principal, Ladies' College, Cheltenham. A senior mathematical mistress at the Bath Royal School—The Principal, Royal School, Bath. A master for chemistry, physics, and mathematics at Connell's Institute, Belfast—The Principal, Connell's Institute, Belfast. Teachers of third year machine design and third year engineering calculations, under the Croydon Education Committee—The Principal, Central Polytechnic, Scarbrook Road, Croydon.

Our Astronomical Column.

THE PLANET MERCURY.—*Revue Scientifique* of Aug. 11 contains an illustrated article on this subject by M. L. Rudaux, who has been observing the planet at intervals since 1893 at his observatory at Douville. His aperture of 4 inches is rather small for this purpose, but he enjoys a good atmosphere, and several of the sketches reproduced show a considerable amount of detail. His chart of the planet resembles in many of its features that published a year ago by M. E. M. Antoniadi from his studies with the great Meudon refractor. Both charts show the dusky regions much broader than the narrow streaks in Schiaparelli's chart; for some markings all three charts agree, so these can be accepted with much confidence.

Schiaparelli and Antoniadi both considered that the planet's equator coincides with its orbit plane, but Rudaux suggests that there is an angle of 10° between them, the summer solstice of the northern hemisphere occurring a little after perihelion. He agrees with the other two in making the rotation coincide with the revolution (88 days), so that a large region has perpetual day, and another large region perpetual night. Owing to the very unequal motion in the orbit, arising from the large eccentricity, the region of perpetual night extends over only 133° of longitude instead of 180° for a circular orbit.

A BIG SUNSPOT.—During the latter part of September it was possible for a few days to see at the same time two spots on the sun's disc as naked-eye objects. The first spot to be seen crossed the central meridian on Sept. 24. On the same day a moderate magnetic disturbance, commencing with a typical 'sudden commencement' at 16½ h., was recorded at Greenwich. This disturbance, which lasted until about 2 h. on Sept. 26, had a range in declination just exceeding ½°.

The second spot, or rather group of spots, was a remarkable one. When first observed near the east limb, it appeared as a 'bipolar' group or stream developing in the usual manner, but within four days it had grown rapidly and had become an immense complex group. Approximate measures of its area, corrected for foreshortening, in millionths of the sun's hemisphere, are given at intervals of 48 hours—

Sept. 22.	Sept. 24.	Sept. 26.	Sept. 28.
600	1400	2500	2500

Changes in structure were especially noticeable between Sept. 24 and 25. Judged from its maximum area, this is the largest group which has appeared since the great spot of January 1926.

No further magnetic disturbance of any note had occurred, however, up to 10 h. on Oct. 1.

Other particulars of the two spots are given as follows, the areas being expressed as the proportion of the hemisphere covered.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
8	Sept. 18—Sept. 30	Sept. 24·4	15° N.*	1/750
9	Sept. 21—Oct. 3	Sept. 27·4	15° S.	1/400

* A large spot in the same latitude and longitude crossed the central meridian on July 31 (see NATURE, Sept. 22, p. 453).

Research Items.

The Moriori of Chatham Island.—Vol. 9, No. 5 of the *Memoirs of the Bernice P. Bishop Museum*, is a further study of the Moriori, which is the result of a second visit paid to Chatham Island by Mr. H. D. Skinner in 1924, supplemented by an account of their life and customs by Mr. William Baucke. This supplements and extends the conclusions at which Mr. Skinner arrived in his previous memoir, as well as corrects other accounts which he considers vitiated by faulty evidence. He is of the opinion that there were two influxes of the Moriori into the Chatham Islands, of which the southern, the Rauru, was pre-eminent, but holds that the Moriori claim that they were autochthonous is incredible. The theory that the islanders were immigrants from New Zealand is fallible, unless it can be shown that the two types co-existed in New Zealand or that two immigrations into New Zealand were repeated in the same successive and separate manner in the Chatham Islands. It is possible that the northern and weaker strain was the first to arrive and began to decay on the arrival of the second; but there is no evidence to show whether the northern Wheteiria or the southern Rauru was the first. Nothing is known of inter-tribal wars which can be construed as history, while there is no evidence for the construction of the fortified villages on the lines of the Maori *pa*, which have been attributed to them, the suggestion that there were being due to knowledge of such structures obtained from Maori stories. Notwithstanding their genealogies, the evidence of the deeply rutted native paths in hard cemented quartzite points to a stay in the islands of not less than a thousand years.

Eye Protection.—Owing to the recent legislation in the United States on the protection of the eyes of workers from injurious radiations, the Bureau of Standards has investigated the best methods of testing the opacities of the glasses used for that purpose, and their results are given in *Technologic Paper*, No. 369. In the case of ultra-violet radiation, the best source is the quartz mercury arc, but the carbon arc with nickel or aluminium cored carbons, or the gas-filled tungsten incandescent lamp may be used. The transmission is measured by the spectroradiometer. For visible radiation a 500-watt 110-volt gas-filled tungsten lamp is used and the transmission measured by photometer. For the infra-red the tungsten lamp is again used, but the transmission is measured by a thermopile with a red glass covering it. The thickness of the glass plates tested is about 0·2 cm. Tables are given of the properties of more than eighty glasses manufactured by eleven American glass makers, and nine other substances, including fused quartz.

Trematodes of Birds.—The attention of workers on the trematodes of gulls, scoters, and other marine birds is directed to a paper by Edwin Linton (*Proc. U.S. Nat. Mus.*, vol. 73, art. 1, 1928), in which trematodes taken from birds at Woods Hole, Mass., are described and figured. These include new species of *Hæmatotrephus, Psilostomum, Petasiger, Himasthla, Apo̊rchis, Ascocotyle, and Minuthorchis* (n. gen.).

Three Species of Bird Malaria.—E. Hartman (*Arch. f. Protistenkunde*, **60**; 1927) points out that the nomenclature of the parasites of bird malaria is very confused. He proposes to restrict the name *Plasmodium præcox* to a parasite in birds having crescent-shaped gametocytes and not markedly different in its morphology from *P. falciparum* of man. He describes two new species of *Plasmodium* which have spherical gametocytes; in *P. cathemerium* these contain rod-shaped pigment granules and in *P. inconstans* nearly spherical pigment granules. All three species were found in Nature in the English sparrow in the United States and have been grown experimentally in the canary.

Ineffectiveness of Internal Medication of Poultry for Control of External Parasites.—In view of a general impression among farmers and poultry-men that certain substances administered internally will protect animals from external parasites, the United States Department of Agriculture has carried out investigations on the subject (*Tech. Bull.*, No. 60; 1928). The prevailing idea is that the substance administered is taken up by the blood and excreted on the surface of the body or on the body-coverings, and when the external parasites come in contact with the material they are thereby poisoned or repelled. Hens were used in the experiments, and the substances tested included magnesium sulphate, naphthaline, calcium thiosulphate, sulphite, sulphate and sulphide, sodium carbonate and sulphate, potassium iodide, tartar emetic, sulphur, camphor, powdered tobacco, and quinine sulphate. The tests show conclusively that the external parasites of the hen are not adequately controlled by internal administration of these substances. Such treatment not only involves useless expenditure but also allows the parasites to continue their ravages when they might be destroyed by recognised methods.

The Long-tailed Shrews of North America.—In 1828, when Sir John Richardson described the mammals of the preceding Franklin expedition, only three species of shrews were known from the American continent, and now Hartley H. J. Jackson has examined 10,431 specimens belonging to the genera *Sorex* and *Microsorex*, and finds that they constitute 89 forms belonging to 39 species, all of which he describes in detail (*U.S. Dept. Agr., Bureau of Biol. Surv., North American Fauna, No. 51*, July 1928). Shrews are in many respects primitive mammals; their fur shows no sharp distinction into underfur and overhair, they exhibit little individual variation, no sexual variation, and little variation with age. Seasonal variation, associated with the spring and autumn moults, is limited to the length and tint of the pelage, and geographical variation is shown in variations of paleness and darkness, in size, in tail length, and in the general shape of the skull, particularly in the contour of the brain-case and the length of the molar tooth row. Individual sub-species generally have an extensive geographical range. Of their habits, perhaps the most remarkable are their savage voraciousness (one individual has been known to devour its two companions in the course of eight hours), their normal gluttony (they have been known to eat their own weight in meat every three hours), and the aquatic perfection of the water-shrews, some of which are said to swim with relatively greater speed and skill than the otter, and must be ranked amongst the best swimmers of non-marine mammals.

The Treatment of Fish Diseases.—During the year 1927 fifty-seven institutions and individuals in various parts of the world were circularised in an effort to gather data from those who had studied the diseases of fishes. In *Zoopathologica*, vol. 2, No. 1, April 30, 1928, Ida Mellen gives tables which describe the symptoms of a large number of ailments suffered by aquarium fishes and show the treatment recommended by various investigators. These tables can

scarcely be dealt with in a short note, but they merit the attention of those either responsible for or interested in the health of fishes in public or private aquaria.

DEVELOPMENT *IN VITRO* OF THE OTIC VESICLE OF THE CHICK.—Dr. Honor B. Fell (*Arch. f. Zellforsch.*, 7, 1928) has investigated the development *in vitro* of the isolated otocyst of the embryonic fowl. The otic vesicle was dissected from one side of a three-day chick, and placed in a tube on the surface of a clot of plasma and embryo extract, and maintained at 38° C. The otic vesicle of the other side, with its adjacent tissue, was fixed and sectioned. The explanted vesicle was washed every 48 hours in a drop of embryo extract and transferred to a tube with fresh culture medium. Such vesicles gave rise to all the epithelial constituents of the fully formed auditory labyrinth. Regions of tissue identical in histological structure with the normal ductus and saccus endolymphaticus, sensory areas (including Corti's organ) and the tegmentum vasculosum were formed. The principal epithelial structures developed in these cases in approximately the same relative positions as the corresponding structures in the normal embryonic labyrinths; as compared with the latter, the rate of tissue differentiation in the explanted otocysts was almost normal, but the growth rate was greatly diminished, and there were only slight indications of anatomical differentiation, the tendency being towards the retention of the primitive vesicular form. The author concludes that the normal histological differentiation of the otocyst of the three-day embryonic fowl does not depend upon a vascular system, nervous connexions, association with adjacent organ rudiments, a correlative anatomical differentiation, or a normal rate of growth.

THE ROOT AS AN ABSORBING ORGAN.—In two recent papers, Scott and Priestley re-examine the question of water absorption by roots, and make suggestions tending towards a more simplified view of the whole problem of root absorption (*New Phytologist*, vol. 27, No. 3). The absorbing region of the root is the area lying between the apical meristem and the region with completely suberised membranes. Now the protoplasts of the endodermis are attached to the radial walls of the cells, and thus form a continuous protoplasm membrane round the central cylinder. The authors consider that when water is present in excess the soil solution permeates the cellulose walls of the cortex, and water can be drawn across the endodermis by the osmotic pull of the solution inside the central cylinder. Thus the absorbing surface of the root is considered to be a definite area of endodermis, and the surface area of the root not important. In drier soils, water is less free to move in the soil, and importance attaches to the increase in root surface due to growth and the production of root hairs, since the rate of entry of water from the soil into the root surface necessary to maintain an adequate supply across the endodermis diminishes in direct proportion to the ratio of root surface to endodermal surface. Therefore, in comparatively dry soils, root hairs perform an important function in relation to the entry of water. Experiments with lead salts and dyes showed that the suberised cells of the exodermis are not permeable to these substances, but the unsuberised cells act as passage cells. They may become blocked in older regions. The distance behind the meristem at which suberisation of membranes appears, varies with the season. Examples from diverse groups of plants show that the typical absorbing zone may be eliminated by the development of suberised exodermis and endodermis to within a short distance of the root apex, and the completion of the closure by fatty impregnation of the walls of the superficial cells.

WIND AND TIDE IN THE IRISH SEA.—In an article on this subject in the *Marine Observer* for October, Mr. M. Cresswell gives some account of observations at the ports of Holyhead, Fleetwood, Preston, and Belfast. These observations show that wind force associated with a rapid change of pressure, that is a sudden gale, alters the sea-level more quickly and to a greater extent than a more gradual change of pressure and wind. On one occasion an excess height of 10 feet occurred in the tide during the passage of a heavy westerly gale. This was the cause of the disastrous floods at Fleetwood and Preston about the end of October last year. The outstanding feature of the year in the area under consideration was the correlation of a mean pressure below the normal with tidal heights departing from the predicted levels. Detailed observations are not given in the paper except in regard to the October gale.

RAINFALL OF AUSTRALIA.—The rain map of Australia for the year 1927 gives maps of the monthly and annual rainfall and maps showing the departure from the average fall. The year showed an improvement on the last five years, inasmuch as 34 per cent of the country had a rainfall exceeding the normal. In previous years the average was 25 per cent of the country. Not since 1921 has 50 per cent or more of the country had an excess. The excess was, however, localised and experienced mainly in the more arid regions of Western Australia and in eastern Queensland. In the greater part of the central plains in Queensland, South Australia, and New South Wales, severe drought conditions again occurred. The agricultural season (April to November) was characterised by several critical periods of rain shortage, but in October the fall improved and the resultant harvest, though below normal in the eastern States, was better than had been anticipated. In Western Australia the wheat and pastoral lands had one of the best of recent years. The maps are based on the records of 1300 stations, and the only area without data is the interior of Western Australia and the adjoining parts of South Australia and the Northern Territory.

THE GILBERT MAP OF 1582–83.—In the sale of the library of Lord Leconfield in the spring of this year, there came to light among a number of documents relating to the early history and geography of America a hitherto undescribed manuscript map of North America and the Arctic regions inscribed with the name of 'Humfray Gylbert.' A reproduction of this map, with an article on its significance by Mr. B. P. Bishop, appears in the *Geographical Journal* for September. The map appears to have been drawn, at latest, in 1583, the year in which Gilbert sailed on his last voyage to Newfoundland. It bears the symbol of Dr. John Dee, who is known to have been interested in projects for colonisation and so may be regarded as partly his work. The chief interest in the map lies in the light it throws on Gilbert's project of the discovery of a sea-route to China by the north-west, and helps to explain his motives in his voyage to Newfoundland in 1583. A strait is depicted as joining the St. Lawrence with the Gulf of California, and so forming a route by which an English colony might be carried to the Pacific coast of America without encroaching on the Spanish sphere of influence. Mercator in 1569, and Ortelius in 1570, had shown the St. Lawrence as a river without any opening to the west, and Gilbert's emendation of the map was apparently done to enhance the chance of his proposals finding acceptance.

Cardita beaumonti Beds in Baluchistan.—The description of the fauna of the *Cardita beaumonti* beds of India was originally entrusted by the Geological Survey of India to the late Maurice Cossmann, who, however, found himself obliged before his death to delegate the task to Prof. H. Douvillé. The latter has already dealt elsewhere with the fauna of their western extension into Persia, and here devotes his first part, which is in French, to an account of the fossils of the Baluchistan representatives of the formation (*Pal. Ind.*, New Series, vol. 10, No. 3). The beds there are characterised by the abundance of Cerithiidæ and Melaniidæ, among them being a representative of the rare genus, *Pseudoglaucoma*, first described by the author from the Eocene of Peru. The fauna indicates sublittoral or lagoon conditions, and if certain species have their analogues in Parisian Tertiary, they point also to the existence of a warmer environment. Thirty-four species are dealt with, of which just one-half are considered to be new, while five are indeterminate. There are four photo-type plates, which are as good as the process permits of.

Pacific Ocean Land Snails.—Under the comprehensive title of "Land Snails from Hawaii, Christmas Island, and Samoa," by H. A. Pilsbry, C. M. Cooke, jr., and Marie C. Neal, a collection of five papers has been issued by the Bernice P. Bishop Museum (*Bull.* 47). In the first on "*Georissa*, a . . . genus new to the Hawaiian Islands," Dr. Pilsbry describes three new species. Investigation of the "Food habits of *Partula zebrina*, Gould," by C. M. Cooke, founded on specimens taken in American Samoa, goes to show that this herbivorous mollusc has acquired the habit of swallowing other species of snails whole—it is presumed solely with the object of procuring lime. The same author seeks to identify and define "Three Endodonta from Oahu," entering fully into their shell characters and anatomy. Mr. Cooke and Marie C. Neal deal with the "Distribution and anatomy of *Pupoidopsis hawaiiensis*." All the Hawaiian specimens are fossil, but living examples were found on Christmas Island more than 1200 miles distant. The authors conclude that both in shell characters and anatomy *Pupoidopsis* is closely related to *Pupoides*. In her "Anatomical Studies of Achatinellidæ," Marie C. Neal seeks to answer the question: Do the genera and species of Achatinellidæ differ anatomically? The results of her careful investigations go to show that divisions of the family by shell characters and by anatomical characters do not agree, but that the section *Perdicella* should have generic rank, whilst the similar claim already made for *Newcombia* is confirmed. The series of papers, which are illustrated by text figures, is a worthy addition to the contributions of the Museum.

The Dielectric Constants of Ammonia, Phosphine, and Arsine.—The *Journal of the Indian Institute of Science* (vol. 11a, Part V.) contains an account of an investigation by H. E. Watson of the variation of the dielectric constants of ammonia, phosphine, and arsine with temperature and pressure. It was not possible to extend the work to stibine, as its ready decomposition with the formation of a metallic mirror would result in the breakdown of the insulation of the gas condenser. The measurements were made at high frequency, two coupled oscillating systems being employed, and an accuracy of 1 per cent was aimed at for the final results. It was found that ammonia and phosphine approximately satisfy Debye's equation for the change in dielectric constant with temperature, while arsine appears to behave similarly to the permanent gases in this respect. The variation of dielectric constant with pressure indicated that it is justifiable to assume that $\epsilon - 1$, where ϵ is the dielectric constant, is proportional to the density. The value of the electric moment is greatest for ammonia and smallest for arsine.

A Frequency Standard.—It is interesting to notice that engineering physicists are beginning to question whether the accuracy of the rate of the earth's rotation round its axis is sufficient for their measurements. If the length of the day alters by about one second in ten years, this would soon cause an appreciable discrepancy between reference standards. Hence they are beginning to consider whether something more fundamental than the rate of the earth's rotation should be adopted as a standard. In the *Bell Laboratories Record* for August, W. A. Marrison points out that in electrical communication we have to work with frequencies ranging from less than unity per second to a hundred million or more per second. It seems now possible to maintain frequencies constant to one part in ten million, for several seconds. In fact, in successful television this is done. The new form of reference standard which has been developed is an oscillator controlled by a quartz crystal. The equipment used by the Bell Company for determining the frequency of the crystal is somewhat similar to that used with a tuning-fork standard. A clock is driven by a synchronous motor controlled by a current the frequency of which is an exact submultiple of the frequency of the crystal. When the high frequency has its normal value the clock keeps accurate time; any variation in the rate of the clock is a measure of the error of the standard. So constant is the frequency of the crystal that the clock controlled by it keeps time with a maximum inaccuracy of less than one-tenth of a second per day. In the crystal oscillator standard at present in use, the frequency is 50,000, and the derived frequency of the current which actuates the clock is 1000. The temperature coefficient of the crystal is much smaller than that of a steel tuning-fork, but it is necessary to control the temperature to within about the one-hundredth of a degree centigrade. The accuracy of the beat frequency measurement when interpreted as the accuracy of the oscillator is increased many times.

New Low-power Binocular Microscope.—Messrs. R. and J. Beck, Ltd. (69 Mortimer Street, W.1), have introduced a new form of low-power binocular microscope, the 'Beck Binomax.' It consists of two complete microscope systems, each with a prismatic erecting arrangement, inclined to each other at the natural convergence of the eyes, the interocular distance being adjustable. The object glasses are held in tubular mounts with the lenses at one end. Each object gla[ss] is so threaded that it may be inserted in the tube either way, so that the tubular mount projects out of, or inside, the body tube. The distance between eye-piece and object glass is thus variable, and two different powers are obtainable, without interfering with the optical performance. Two pairs of eye-pieces of different powers are provided, and four powers in all are therefore available, with magnifications of 4, 8, 16, and 32 respectively. Various stands for the 'Binomax' are obtainable, and the body may be used interchangeably on any form of Beck stand listed. The working distance is considerable—110 mm. for the two lower powers, and 75 mm. for the two higher ones. We have inspected the instrument and its performance is excellent; it should be of great service for the examination of large opaque objects, such as rock specimens, for dissections, and other purposes.

Wordsworth as a Pioneer in the Science of Scenery.[1]

By DR. VAUGHAN CORNISH.

THE pre-eminence of Wordsworth as a poet of Nature has long been recognised, but there is another aspect of his originality which has not yet received adequate recognition. Wordsworth wrote "A Guide through the District of the Lakes in the North of England with a Description of the Scenery," which appeared in several editions between 1810 and 1835. The "Guide" proper is brief, the author regarding this portion of his task as "humble and tedious," and he soon plunges into his description of the scenery. Here at once we find scientific originality, for he not only records physical appearances, but also, whenever they give keen enjoyment, seeks the source of the impression, investigating both the objective conditions and the mental qualities concerned in their appreciation. Moreover, he writes in the hope that his essay may lead to habits of "more considerate observation than have been hitherto applied to local scenery."

Consideration saved Wordsworth from the sentimental assumption that the aspect of Nature is always harmonious. He points out, for example, a 'defect' in the colouring of the Country of the Lakes. But his faculty of observation made him quick to recognise the conditions in which objects in the view enhance one another, the harmonies which are the true beauties of scenery. Thus he directs attention to the circumstance that the radial arrangement of the English Lakes from a mountainous centre introduces every variety of the sun's shadowing. He points out that the mountains of the district differ from hills not merely in mass but quality, owing to the atmospheric absorption which etherialises the summit when viewed from the valley. He notes the height which must be attained that "compact fleecy clouds" should settle upon the crest. Among "the varied solemnities of the night" he recognises the singular charm of stars which "take their stations above the hill tops"—an excellent observation of enhancement due to a momentary and accidental relation. He feels the romantic, almost poignant interest of the line of the trees which maintain themselves against the elements at the limit of altitude. The charm of intermingling of field and woodland in the Lake Country he traces skilfully to the progressive agricultural settlement which followed "the veins of richer, dryer, or less stony soil." With equal acuteness he indicates how the peculiar economic character of the district has resulted in innumerable lanes and paths which provide the rambler with "an ever ready guide" to "the hidden treasure of its landscapes."

Although preferring the harmonies of occupation and environment displayed in a highland community of small owners before all other aspects of the scenery of civilisation, Wordsworth pays discriminating tribute to the unique contribution made by wealthy inheritors of landed estate in the preservation of trees beyond economic prime for sheer love of their beauty in venerable age. He notes the geological conditions to which the water of the English Lakes owes the remarkable clearness that makes their depths a magic mirror to lead the mind into "recesses of feeling otherwise impenetrable." He does not, however, discover the peculiarities of the watery image which are the source of this mental effect. We must remember that Wordsworth was making a beginning only in the science of scenery, and that with the advantage of another hundred years of accumulated knowledge we can better his instruction. But even so it is remarkable that we should now be taking up the æsthetics of scenery very nearly from the point where he left it, joining hands across a hundred years, rather than proceeding from the mainly orographical studies of scenery produced in the latter part of the nineteenth century.

The "Guide" proper and the "Description" are followed by the third section of the book, which is on "Changes, and rules of taste for preventing their bad effects." Wordsworth dates a more general appreciation of the wilder aspects of scenery from about the year 1775. Thereafter the country of the English Lakes not only attracted visitors, but also, owing to its economic conditions, offered more opportunities for settlement by villa residents than districts parcelled out in great estates. The epoch of railway construction followed, with the result that the changes in the English Lake District in Wordsworth's middle and later life were comparable to those which, owing to the development of motor traffic and the extension of house building, now affect rural England as a whole. Wordsworth points out to the newly-arrived resident that the liking for "strong lines of demarcation" and emphatic contrast is due to want of practice, and that if he will pause to study his rural surroundings "a new habit of pleasure will be formed the opposite of this, arising out of the perception of the fine gradations by which in Nature one thing passes away into another." The rule that a house situated in mountain scenery should be so designed as to take its place quietly in the landscape is enforced by the penetrating remark that owing to the scale of the view "a mansion can never become principal in the landscape" as it may "where mountains subside into hills of moderate elevation."

This example of Wordsworth's *flair* for noting the relation of the object of attention to its environment is curiously paralleled by his observation of the effect of the echo of the cuckoo's call from the steep sides of the Rydal Valley. The sound, he says "takes possession" of the valley, an expression which is implicit with suggestion of the important fact that the view is made impressive by any agent which imparts unity to objects the multiplicity of which often prevents the landscape from appearing to the mind as a picture. Here I pause to remark that the sounds and scents of the countryside belong to its scenery. If we did not make the letter *c* soft in the word scenery we should be less apt to forget that the word has no derivational connexion with 'seeing.' The visual is no doubt the leading aspect of scenery, but æsthetically we are bound to take account of the simultaneous impression of the natural environment, or scene, upon the other senses. It follows that the societies which concern themselves with the preservation of scenic beauty are within their province in combating unnecessary mechanical noise.

When changes come, Wordsworth is not always apt in recognising a new harmony. His failure to observe the rhythmic reinforcement of rocky pinnacles by trees of pointed form diminishes the efficacy of his protest against the introduction of the larch. His preference for informal lines may have been partly innate but was increased out of measure by intellectual associations, which do so much to cramp the proper functioning of the eye. Thus in the letter to Sir George Beaumont, dealing with the laying-out of grounds, written so early as 1805, which is included as

[1] Paper read at the Conference of Delegates of Societies of the British Association, session of Sept. 1: the scenery of the English Lake District and its

an appendix in Mr. de Selincourt's recent collation of the editions of the "Guide," Wordsworth assumes that every person of taste would prefer that the whole garden should be as near to Nature as possible, and pays no regard to the circumstance that in the immediate vicinity of the mansion it is permissible to prefer formal lines on account of their harmony with those of architecture. Thus, although Wordsworth may have been in advance of his time as an advocate of the free play of the senses, he did not go so far as we now know to be desirable.

Mr. de Selincourt has included as a second appendix letters to the *Morning Post* written by Wordsworth in 1844 on the subject of the proposed Kendal and Windermere Railway. Descending to the dusty arena of practical affairs, his academic mind loses something of its lofty detachment. It is interesting to compare these letters with a recent work entitled "England and the Octopus," dealing with the things that to-day impair the peacefulness of our scenery. The style of Wordsworth is indeed less trenchant than that of Mr. Clough Williams-Ellis, but underlying exasperation is almost equally evident. On the whole, however, it is when Wordsworth is dealing with general principles that he is of most service to the cause which so many of us have at heart, the preservation of scenic beauty, and we may well take the concluding paragraph of his "Description" as the text of our present appeal for preservation of scenic amenity in the countryside generally and the district of the English Lakes in particular:

"It is then much to be wished that a better taste should prevail among these new proprietors; and, as they cannot be expected to leave things to themselves, that skill and knowledge should prevent unnecessary deviations from that path of simplicity and beauty along which, without design and unconsciously, their humble predecessors have moved. In this wish the author will be joined by persons of pure taste throughout the whole island, who, by their visits (often repeated) to the Lakes in the North of England, testify that they deem the district a sort of national property, in which every man has a right and interest who has an eye to perceive and a heart to enjoy."

Jubilee Congress of the Folk-lore Society.

THE Jubilee Congress of the Folk-lore Society was held, as previously announced, on Sept. 19–25 in London, the president being the veteran scholar, Lieut.-Col. Sir Richard C. Temple. With the exception of one session on the evening of Sept. 20, which was held at the Imperial Institute, the meetings were held in the rooms of the Society of Antiquaries, which had been placed at the disposal of the congress by the Council of that body.

The congress, though small in numbers, was distinguished in its membership, and a number of prominent folk-lorists from abroad were present, mostly representing continental or American bodies. Among them were Dr. Fritz Boehm, of Berlin, representing the Vereins für Volkerkunde; Dr. Gudmund Schütte, of Sweden; Miss A. W. Beckwith, representing the Folk-lore Foundation of Vassar College, N.Y.; Dr. Marcu Beza, of the Rumanian Academy; Prof. Y. M. Goblet, of the Société Ernest Renan, Paris; Prof. R. Pettazoni, of the Universities of Rome and Bologna; and Dr. Rütimeyer, of the Schweitzer Gesellschaft für Volkerkunde. A number of British societies were also officially represented.

It may not be inopportune to recall that when the Folk-lore Society was founded in 1878 by a small band of enthusiasts, among whom the late William J. Thoms and the late Mr. (afterwards Sir) Laurence Gomme were the leading spirits, the subject of its study had hardly won a generally recognised name. There would also seem to have been no very precise agreement as to its exact object and scope. So much so that, even in a leaflet published on behalf of the Society some years later, it was felt necessary to explain in what respects the science of folk-lore differed and was distinguishable from other studies with which it was in danger of being confused. The reason for this, of course, was that the Society had not confined itself to the study of survivals among civilised populations and the collection of folk-tales, but had included the study of certain aspects of 'savage' culture within its scope, and might, therefore, have been thought to be encroaching too broadly upon the province of ethnography.

On many occasions Sir Laurence Gomme in his writings, and notably before the Anthropological Section of the British Association, endeavoured to lay down the line of demarcation of his studies. Although the lines may have been overstepped, in general and as a matter of practice, the field of operations has been well marked out. Its original aim was two-fold: the collection of the customs, beliefs, sayings, etc., of the folk, and secondly, the classification, comparison, and interpretation of the matter thus collected. A valuable handbook for collectors was prepared which has been revised as the development of the study has required, and the work of the Society has been recorded in a journal which has been supplemented by the publication of supplementary volumes, either original studies too lengthy for inclusion in the journal or reprints of 'classics' of folk-lore almost unobtainable in their original or indeed in any form.

It is worth while to recall these facts in connexion with this congress, for it cannot but be felt that the Society and the study it represents are not receiving in this jubilee year the support from the public which they deserve. The study of folk-lore was taken up with some vigour on the Continent, where the term, first used by W. J. Thoms and adopted in England to distinguish the subject, was accepted as the official designation of the study of the culture of the people.

The recognition that is now accorded such studies on the Continent is indicated by a communication presented to the congress by Dr. Fritz Boehm, in which he surveyed the academic position of folk-lore in Germany. In Prussia folk-lore, since the educational reform of 1925, is being introduced into the curricula of the elementary school, the secondary school, and the university, and other States will probably follow this example. In fact, it is represented in some form or other in most German universities. Yet Dr. Boehm lamented the fact that Germany is behind Scandinavia in this respect, as was in part borne out by Dr. A. Cyriax's account of the study of folk-lore and art in Sweden and the museums devoted to it. While this is not the occasion to enlarge upon such reflections as this contrast with conditions in Great Britain may suggest, it is perhaps worth while to point out that, though the important work of collection must not be neglected now that the material is disappearing more rapidly than ever in the stress of modern life, too little attention may be given to the work of analysis, synthesis, and comparison which gives meaning to the isolated facts and keeps alive the interest of an intelligent but uninstructed public.

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quality of the papers was concerned the congress was a success. The meetings were well attended and the papers followed with close attention, even in those few cases in which the authors were not able to attend in person.

The president, Sir Richard Temple, a contributor to the proceedings of the Society almost from its inception, in his address on "The Mystery of Mental Atmosphere," dealt with a topic of no little philosophic import. He sought the origin of magic in the attempt of the primitive mind to bridge the gap that philosopher and savage alike reach at the point which is beyond experience and passes understanding. Recalling an observation of his own on a voyage to Rangoon, which revealed to him that a personage, al-Khidr, had been identified among the people with almost every hero of the past and many smaller local ones, he argued that such beings as this represent to the populace the unknown and mysterious by which they endeavour to bridge the gap, while the mind, clinging, as Andrew Lang suggested, to whatever it absorbs, modifies it, and by each contact produces an atmosphere which overlaps but never destroys those produced by previous contacts. Folklore, therefore, to be scientific in studying any given belief, should ascertain the mental atmosphere at the time of absorption of the people who had absorbed it.

The proceedings of the congress covered a wide range, both geographically and in subject matter. One of the most striking papers in its choice of subject was a study of stone-carrying women, by Mrs. Banks, who has followed up the persistent story in western Europe of women who dropped stones from creels on their shoulders or from their aprons, among whom even the Virgin Mary found a place. She sought to connect the legend with the clearing of land by women as early agriculturists.

Several contributors offered papers on extra-European folk-lore. Prof. Sayce, who was one of the original members of Council of the Society, dealt with Egyptian folk-lore, as did Miss Blackman in its medical aspect; Mrs. Spoer (Miss Goodrich-Freer) with Hebrew amulets; Capt. M. W. Hilton-Simpson with medical magic in Algeria. Prof. Starr sent a communication on Filipino magic, and Mr. R. E. Enthoven described beliefs connected with tree and animal worship in India, and showed the identity in the conception of tree, animal, and human soul.

Among papers dealing with the Near East were Prof. R. M. Dawkins on the study of folk-lore in modern Greece, and an interesting account of mummers' plays in Attica by Prof. H. J. Rose. Mrs. Hasluck described "the most primitive people in Europe outside Russia"—the Sarakachan people, who spend the summer in the Pindus mountains and the winter in the plains of Macedonia. She has visited two branches of these people, one the Albanian Vlacks, and the Sarakachan peoples proper, who, curiously enough, owing to local conditions, have reverted from a settled to a nomadic life. Dr. Beza gave the congress a view of Rumanian folk-lore in his account of the work of Demetrius Contemir's contribution to folk-lore, and Prof. Gudmund Schütte dealt ably with the evidence for the worship of the bull among the Kimbri. In the evening session at the Imperial Institute, Prof. Pospisil, of Brno, gave an account illustrated by a kinematograph film of the folk dances and customs of Central Europe.

British folk-lore was well represented, and offered one of the most interesting of the papers presented at the congress in an account of witchcraft in Wales, of which perhaps the most striking feature was the extent to which the belief is still prevalent among the educated. A witch has been considered a more efficacious thief-finder than a policeman, and a piece of moleskin worn on the chest of more avail than a doctor. The use of written charms in English suggests an English origin for some forms of the belief. Mr. T. W. Thompson's interesting account of British gypsy marriage and divorce customs included references to the eating of the blood-cake and the jumping of the bride and bridegroom over a branch of flowering broom or a besom—made of broom. A paper was presented on behalf of Canon MacCulloch discussing aspects of the Arthurian legend, and Miss Mona Douglas gave an account of various beliefs relating to animals in Manx folk-lore, according to which cows were held most susceptible to witchcraft, and the witch was believed to take the form of a hare. Miss B. C. Spooner described 'charming' in Cornwall, the counterpart of the modern faith-healing. A suggestive paper by Prof. Pettazzoni on confession among primitive people, described the confessional as an analogue of the expulsion of sin or disease by washing or drawing of blood, the evil being expelled by verbal enunciation.

A fitting climax to the prominence of witchcraft in the proceedings of the congress was a communication from M. P. Saintyves, which was read by M. Goblet, on the 'witches' sabbath,' in which the author maintained the existence of a magic religion and secret church of wizards in the Middle Ages.

The programme on the concluding day included papers on the psycho-analytic side of folk-lore. Dr. Ernest Jones, in dealing with the question generally, made special reference to the significance of beliefs relating to the number three. Dr. Roheim dealt with "Mother Earth and the Children of the Sun."

The social side of the congress was not neglected. It opened with a presentation of the delegates to the president by Prof. J. L. Myres, and the members were entertained by Dr. Henry Wellcome at the Historical Medical Museum, and by Mr. and Miss Canziani. Visits were paid to Oxford and Cambridge; the English Folk Dance Society gave a demonstration of folk-dances, folk-songs, and children's singing games; and an official dinner was held on the concluding day.

Energy and Atoms.

A MESSEL memorial address, entitled "Available Energy," was delivered by Prof. R. A. Millikan on Sept. 5 in New York at a joint meeting of representatives of the British Society of Chemical Industry and the Institution of Chemical Engineers with the American Institute of Chemical Engineers. As might be expected from Prof. Millikan's recent researches, his treatment of his subject proceeded upon somewhat unorthodox lines, and in the greater part of his lecture he was concerned with astronomical problems, rather than with the physical and engineering thermo-dynamics suggested by his title. The apology he made for offering an apparently abstract subject of this nature to a technical audience was the fact, perhaps usually insufficiently appreciated, that many of the distinctive features of modern civilisation come from our present knowledge of mechanics, which, in turn, was largely developed through the pioneer work done in the seventeenth and eighteenth centuries upon extra-terrestrial problems.

The fundamental work of Prof. Millikan and Dr. Cameron themselves upon the cosmic rays is by now

Societies and Academies.

PARIS.

Academy of Sciences, Aug. 27.—**G. Bigourdan**: The co-ordinates of the observatory of the rue Sainte-Avoye. The position of Delambre's observatory and extracts from some of his notes.—**L. Joubin**: Various octopod cephalopods from the cruises of the *Dana* in the Atlantic. Amongst the specimens collected by Prof. J. Schmidt, of Copenhagen, were the octopods described. Their peculiarities necessitate a new classification of the lower octopods.—**L. Goldstein**: The equation of probability of wave mechanics.—**Paul Mondain-Monval**: The physical properties of heterogeneous ternary mixtures. The changes in the physical properties of a mixture of ethyl and isoamyl alcohols and water in the neighbourhood of the critical point, noted by P. Brun in a recent communication, were not confirmed: the curve representing refractive index as a function of concentration shows no discontinuity.—**J. Lacoste**: The daily variation of microseismic agitation.—**N. D. Costeanu** and **Al. Cocosinschi**: The rain of ashes of April 26, 1928, at Cernauti and its neighbourhood. An analysis is given of the powder which fell.

GENEVA.

Society of Physics and Natural History, June 21.—**Robert Chodat** and **Florencio Bustinza**: Pseudo-peroxidase, a new indirect ferment acting by means of hydrogen peroxide. From the results of their experiments the authors consider the pseudo-peroxidase extracted from the rhizome of *Cyperus esculentus* as a peroxidasic image of tyrosinase, just as the system peroxidase-peroxide is the image of laccase, which, like tyrosinase, is inhibited by hydrogen peroxide.—**Robert Chodat**: The phases of action of tyrosinase in the cresol blue reaction. The author and his pupils have shown that there are two phases in the action of tyrosinase on the complex *p*-cresol-aminoacid. In continuation of a work of M. Raper, according to which in the course of the oxidation a quinone is formed which is the cause of the removal of amino groups, R. Chodat has made fresh experiments which prove that only the quinone obtained by starting with *p*-cresol leads to this result.—**Alexandre Wissmer**: The trajectorial structure of the fœtal mandible in man. Up to the second month the mandible is represented by Meckel's cartilage, with a thin bony leaflet joined on. At the fourth month the existence of a fundamental trajectory is proved, which only serves as a support up to the time of birth.—**Swigel Posternak**: The limit of degradation of the lactobutyrins by trypsin. Some researches recently published by Rimington are in opposition to certain conclusions of the author: the latter has repeated his experiments on the products of the trypsin digestion of casein, and arrives at his original conclusions. He has isolated, besides the α, β, and γ lactotyrins already described, a polypeptide containing fourteen atoms of nitrogen to four atoms of phosphorus, and this represents the ultimate degradation product of the lactotyrins by trypsin. Amongst the products of hydrolysis, no oxyaminoacid is found other than serin.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 7, July).—**O. G. Ricketson, Jr.**: A stratification of remains at an early Maya site. The Carnegie Institution expedition at Uaxactun, Guatemala, during the season 1928 investigated Stela 20 and an adjacent pyramid. The pyramid proved to be a secondary erection covering an earlier stepped pyramid resting on an early rubbish deposit. Stela 20 seems to have been placed in position resting on the same deposit by digging through two 'floors' laid down after the erection of the stepped pyramid. Stela 20 apparently dates from A.D. 235; the other remains are older, the stepped pyramid being the oldest Maya building known.—**Donald Statler Villars**: The degree of association of sodium vapour. Observations were made of the band spectra of a sodium-potassium alloy and the dissociation of the molecule, Na_2, calculated. Using the theoretical Sackur-Tetrode equation, the degree of association was estimated. Contrary to previous hypotheses, it was found that sodium vapour is mainly diatomic, especially at temperatures below 400° C.—**Erik G. Moberg**: The interrelation between diatoms, their chemical environment, and up-welling water in the sea, off the coast of southern California. The optimum position for diatoms in deep water during the summer of 1926 was 30-35 metres below the surface; above this level the limiting factor appeared to be lack of nitrate, whereas below it the illumination became insufficient. A certain amount of upwelling is required to maintain the environmental conditions.—**G. A. Miller**: Transformation of conjugate elements or of conjugate subgroups.—**Charles F. Craig**: Observations upon complement fixation in infections with *Endamœba histolytica*. Alcoholic extracts of cultures of this parasite, when used as antigens in a complement fixation test, appear to give a specific diagnosis of the presence of the organism. Positive reactions are given only by individuals suffering from *E. histolytica* and by healthy 'carriers.'—**Janet H. Clark**: Reversible crystallisation in tendons and its functional significance. A change of state, for example, from liquid-liquid to a liquid-solid system, may cause changes in surface forces, which can be detected in X-ray diffraction patterns. The patterns obtained from white fibrous and yellow elastic tissue indicate that collagen and elastin exist normally as liquid crystals, but that the former undergoes reversible crystallisation on stretching the tendons. This probably increases cohesion and marks the limit of elasticity.—**G. W. Crile, Amy F. Rowland**, and **Mar[ia] Telkes**: An interpretation of excitation, exhaust[ion], and death in terms of physical constants. Measurements of the potential difference (P.D.) betw[een] different organs and tissues in the rabbit show th[at] physical injury, drugs, etc., cause an immediate f[all] in P.D., followed by some recovery; repeated [or] protracted excitation tends to diminish the P.D., and death occurs when the P.D. approaches zero. After death there is a secondary rise of P.D. in the brain and in voluntary muscle, but it eventually disappears, indicating complete death following clinical death.—**J. A. Bearden**: The polarisation of characteristic radiation. Monochromatic X-radiation [was] scattered from a graphite block at 45° to the [beam] and the intensity of the scattered beam was measur[ed] parallel and at right angles to the beam. In o[ne] experiment the differences between the intensit[ies] when two different filters were used were compare[d]; in another experiment the filters were replaced by [a] crystal of calcite and the graphite block rotated wi[th] the ionisation chamber. No certain evidence [of] polarisation was obtained.—**Carl Barus**: The repul[sion] between electric currents and their induced currents in parallel. An attempt was made [to] measure the pressure on the mercury in one limb of th[e] interferometer U-gauge due to eddy currents caus[ed] by an alternating current traversing a coil above t[he] mercury. The results were not satisfactory.—**R. Cox, C. G. McIlwraith** and **B. Kurrelmeyer**: Appar[atus]

evidence of polarisation in a beam of β-rays. β-rays were twice scattered at right angles from gold targets, and the number entering a Geiger counter were recorded as the angle between the initial and final segments of the path was varied. The essential parts are enclosed in an axial and radial channels in an upright steel cylinder, the top half of which, carrying the β-ray source and the first target, revolves about the bottom half. There is some evidence of true polarisation due to double scattering of asymmetrical electrons, which is confined mainly to the faster electrons.—**A. H. Compton**: The spectrum and state of polarisation of fluorescent X-rays. The line radiation in the spectrum of fluorescent X-rays from silver constitutes 99 per cent of the total radiation. The method is thus very useful for producing homogeneous X-rays; the β- and γ-rays can readily be filtered out, leaving practically nothing except $K\alpha$ radiation. The relative intensities and positions of the α- and β-lines is approximately the same in the fluorescent as in the primary X-rays, and the former are found to be completely unpolarised.—**G. Breit**: An interpretation of Dirac's theory of the electron. Certain terms of Dirac's theory are associated with definite physical quantities and its analogy with Pauli's formulation of the theory of the spinning electron is made more complete.—**R. C. Gibbs** and **H. E. White**: Regularities exhibited between certain multiplets for elements in the second long period. Plotting energy levels against atomic number for iso-electronic systems, lines connecting points for corresponding terms of each successive element are nearly straight lines; radiated frequencies resulting from transitions involving no change in total quantum number are displaced to higher frequencies by nearly a constant value. This applies in the first long period and is now extended to the second long period.—**Gaylord P. Harnwell**: Angular scattering of electrons hydrogen and helium. A large scattering chamber vas used with an electron gun which could be turned hrough nearly a complete circle. After passing through slit in the closed end of a brass tube, the electrons ere caught in a Faraday cylinder; a continuous ow method was used, the pressure in the cylinder ing kept below that in the scattering chamber. ith molecular hydrogen, atomic hydrogen, and with lium, a definite peak in the ionisation curve was erved as the electron gun was rotated. When, ver, the inside of the chamber was given a heavy ating of magnesium, no peak appeared; the peaks erefore appear to be due to electrostatic charges side the chamber. It is concluded that there are o favoured angles for electron scattering from these ases.—**Gilbert N. Lewis** and **Joseph E. Mayer**: hermodynamics based on statistics. (1) It is ssumed that for a system having a certain volume, nergy, and number of particles, the whole field of pecifications which describe the states of the individual particles is naturally partitioned into regions o as to give unique significance to a quantity, log Ω, here Ω represents the total number of different ways which the particles may be distributed among the ns.—(2) The assumption made above leads to uations identical with those of classical thermoynamics.—**David M. Dennison**: A proposed exnent on the nature of light. Suppose a beam of gh-frequency X-rays falls on a single crystal used a diffraction grating, that the intensity of the beam adjusted by filters so that only a few light quanta re transmitted per minute, and that Geiger counters re placed at the position of two Laue spots of equal tensity. On the classical wave theory, groups of aves will be diffracted simultaneously to all orders reflection and the absorptions at the Geiger counters would be simultaneous; on the theory of light quanta, the absorptions would be related only by chance in such a manner that the mean energy arriving at each spot would be equal to that predicted by the wave theory.—**Egon Lorenz**: The spectrum of X-rays from the back of a tungsten target. Under the influence of the electric field, an electron beam hitting a target makes the latter a source of new electron rays ('reflected' rays), which hit the anode over its whole length; the total amount of such radiation is about 24 per cent of the focal spot radiation. With a tungsten anode it is produced mostly by secondary electrons knocked out from the levels of the tungsten atom, and the probability that absorption takes place is a function of the voltage applied to the tube.—**A. P. R. Wadlund**: Absolute X-ray wave-length measurements. A speculum grating with space $2{\cdot}0000 \times 10^{-3}$ cm. was used, and measurements were made at small glancing angles of the $K\alpha_1$ lines of copper, iron, and molybdenum.—**F. Zwicky**: On the thermodynamic equilibrium of the universe. Although the postulate is not justified so far as the distribution of radiation and the equilibrium between matter and radiation is concerned, a consistent statistical treatment of the equilibrium of different forms of matter on the basis of this postulate promises to furnish results agreeing with the facts.—**David White**: Algal deposits of Unkar Proterozoic age in the Grand Canyon, Arizona. Four forms of deposits, referred to blue-green algæ, and two or three doubtful of origin, are recognised.

Official Publications Received.

BRITISH.

First Report of the Joint Advisory Committee on River Pollution. Pp. 8. (London: H.M. Stationery Office.) 2*d.* net.

Imperial College of Science and Technology, South Kensington, London, S.W.7. Department of Aeronautics: Session 1928–29. Pp. 7. (London.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1127 (Ae. 299): Further Development of Autogyro Theory. Parts 1 and 2. By C. N. H. Lock. (T. 2416 and a.) Pp. 43+2 plates. 1*s.* 9*d.* net. No. 1159 (Ae. 324): A Theoretical Estimate of the Pressure Gradient in a Wind Tunnel. By H. Glauert. (T. 2602.) Pp. 11. 6*d.* net. (London: H.M. Stationery Office.)

Australasian Antarctic Expedition, 1911–1914. Scientific Reports. Series C: Zoology and Botany. Vol. 8, Part 4: The Bryozoa. Supplementary Report. By Arthur A. Livingstone. Pp. 98+7 plates. (Sydney, N.S.W.: Alfred James Kent.) 10*s.*

Colony and Protectorate of Kenya. The Forest Department Annual Report, 1927. Pp. 35. (Nairobi.)

The East London College (University of London). Calendar, Session 1928–1929. Pp. 191. (London.) 1*s.*

Education, India. Education in India in 1925–26. Pp. iv+157. (Calcutta: Government of India Central Publication Branch.) 10 annas; 1*s.*

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 1, No. 3: The Geology of the Highland Border from Tayside to Noranside. By Dr. Douglas A. Allan. Pp. 57-88+2 plates+1 map. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5*s.* 6*d.*

Reports on the Organisation and Economic Aspects of Agricultural Research in various Countries. By Dr. Alexander Nelson. Pp. iii+116. (Hobart, Tasmania: Agricultural and Stock Department.)

Proceedings of the South London Entomological and Natural History Society, 1927–28. Pp. xx+125+8 plates. (London.) 12*s.* 6*d.*

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections, 1927–28. Vol. 29. Pp. 60. (Leicester.)

FOREIGN.

Cornell University: Agricultural Experiment Station. Memoir 110: The Effect of Freezing on the Respiration of the Apple. By D. B. Carrick. Pp. 28. Memoir 112: A Survey of Sickness in Rural Areas in Cortland County, New York. By Dwight Sanderson. Pp. 27. Memoir 113: Studies of Protein Metabolism, Mineral Metabolism and Digestibility with Clover and Timothy Rations. By L. A. Maynard, R. C. Miller and W. E. Krauss. Pp. 38. Bulletin 460: Bacteria Count Limits and the Transportation of Milk. By James D. Brew and Richard C. Fisher. Pp. 37. Bulletin 462: Economic Studies of Dairy Farming in New York, viii: Grade B Milk with Cash Crops and Mixed Hay Roughage, Crop Year 1924. By E. G. Misner. Pp. 88. Bulletin 464: An Economic Study of Certain Phases of Fruit Marketing in Western New York. By Roger B. Corbett. Pp. 51. (Ithaca, N.Y.)

United States Department of Agriculture. Technical Bulletin No. 52: A Classification of the Higher Groups and Genera of the Coccid Family Margarodidae. By Harold Morrison. Pp. 240+7 plates. (Washington, D.C.: Government Printing Office.) 50 cents.

Proceedings of the United States National Museum. Vol. 73, Art. 14: Fire-Making Apparatus in the United States National Museum. By Walter Hough. (No. 2735.) Pp. 72+11 plates. Vol. 73, Art. 17: Field Notes on Vertebrates collected by the Smithsonian-Chrysler East African Expedition of 1926. By Arthur Loveridge. (No. 2738.) Pp. 69+4 plates. Vol. 73, Art. 18: Two new Species of Commensal Copepods from the Woods Hole Region. By H. R. Selwell. (No. 2739.) Pp. 5+2 plates. Vol 73, Art. 19: New Moths of the Family Oarnridae (Notodontidae) in the United States National Museum. By William Schaus. (No. 2740.) Pp. 90. Vol. 73, Art. 21: Concerning the Origin of the Metal in Meteorites. By George P. Merrill. (No. 2742.) Pp. 7+3 plates. Vol. 73, Art. 23: Notes on American Two-winged Flies of the Family Sapromyzidae. By J. R. Malloch. (No. 2744.) Pp. 18. Vol. 73, Art. 24: A new Pterosaurian Reptile from the Marine Cretaceous of Oregon. By Charles W. Gilmore. (No. 2745.) Pp. 5. (Washington, D.C.: Government Printing Office.)

Japanese Journal of Mathematics. Transactions and Abstracts. Vol. 5, No. 1, June. Pp. 123. (Tokyo: National Research Council of Japan.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 11, No. 4, July. Pp. 205-301+13 plates. (Tokyo and Kyoto: Maruzen Co., Ltd.) 2.00 yen.

CATALOGUES.

Mycologia: Plantarum Pathologia. Supplementum: Scripta Botanica Miscellanea. (No. 73.) Pp. 54. (Berlin: W. Junk.)

A Short List of Old and Modern Books on Gardening, Horticulture, Botany; including a Selection of Herbals, also Books of Flower Drawings. (No. 509.) Pp. 12. (London: Francis Edwards, Ltd.)

The Taylor-Hobson Outlook. Vol. 3, No. 10, September. Pp. 8. (Leicester and London: Taylor, Taylor and Hobson, Ltd.)

Spectrometric Apparatus (Spectrographs). Pp. 12. Spectroscomparators. Pp. 4. (London: Bellingham and Stanley, Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 5.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers Club, Manchester), at 7.—Dr. W. Hubball: The Chemist and his Message.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. J. Simpson: Interesting Details of Swiss Alpine Railways.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at College of Technology, Leicester), at 8.—C. Ainsworth Mitchell: Some Notable Trials involving Chemical Evidence.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Society of Chemical Industry—London Section) (at Royal Society of Arts).—F. H. Rogers: Factory Floors.

SATURDAY, OCTOBER 6.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Joint Meeting of the South Wales District and the Institution of Civil Engineers (South Wales Association)) (at Cardiff), at 10.15 A.M.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District Meeting) (at Town Hall, Stockport), at 11 A.M.

BIOCHEMICAL SOCIETY (in Biochemical Laboratory, Cambridge), at 2.30.—A. V. Szent Gyorgy: (a) Functions of Peroxidase Systems; (b) Chemistry of the Adrenal Cortex.—E. H. Lepper and C. J. Martin: A Thermostable Autoxidisable System comprised of Boiled Muscle and Hæmochromogen.—B. Woolf: The Estimation of Ammonia, Urea, and Total Nitrogen.—F. T. Grey: The Behaviour of Glucose in Urine.—T. A. Webster and R. B. Bourdillon: Observations on the Irradiation of Ergosterol.—Dr. A. S. Parkes and G. F. Marrian: Observations on the Distribution of Oestrin.—H. D. Kay and F. G. Marshall: The Second Protein (Livetin) of Egg-yolk.—E. Stedman: The Miotic Activity of the Urethanes derived from the Isomeric Hydroxybenzyldimethylamines.—H. J. Holman and Dr. S. B. Schryver: The Separation of the Basic Products of the Hydrolysis of Proteins.—Dr. L. J. Harris: The Zwitterion Constitution of the Amino-acid Molecule. Titration Curves of Methylene Derivatives.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 3.45.—E. Longden: Presidential Address.—Prof. F. Johnson: Oxygen and Metals: Some Features in their Relationship.

MONDAY, OCTOBER 8.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.—Lieut.-General Sir Matthew Fell: The War Section (Presidential Address).

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—L. H. Hounsfield: The Integrity of the Technical Man.

CERAMIC SOCIETY (Pottery Section) (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—S. E. Flack: Chairman's Address.

INSTITUTE OF BREWING (London Section) (at Charing Cross Hotel).—F. W. Cooke, A. Hadley, H. Lloyd Hind, and others: Discussion on Season's Malts (made from 1927 barley).

TUESDAY, OCTOBER 9.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 6.45.—Dr. H. M. Vernon: Methods of Heating and Ventilating Schools and their Influence on Health.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Dr. J. A. Smythe: Chairman's Address.

QUEKETT MICROSCOPICAL CLUB, at [illegible]

WEDNESDAY, OCTOBER 10.

INSTITUTE OF FUEL (at Chemical Society), at 6.—T. A. Peebles: Automatic Combustion Control of Liquid, Solid, and Gaseous Fuels.

BRITISH HOROLOGICAL INSTITUTE (Annual Meeting) (at 35 Northampton Square, E.C.1), at 6.30.—Sir Frank Dyson: The History of the Royal Observatory.

INSTITUTE OF METALS (Swansea Local Section) (in Thomas' Café, Swansea), at 7.—J. H. Grant: Chairman's Address.

EUGENICS SOCIETY (at Royal Society), at 8.30.—L. H. D. Buxton: Primitive Marriage Customs and Inbreeding.

CERAMIC SOCIETY (Building Materials Section) (at North Staffordshire Technical College, Stoke-on-Trent).—A. B. Searle: Modern Facing Bricks.—C. Presswood: Thermal Insulation.—Pragos Engineering Company: Modern Brick Machinery and Works Layout.

THURSDAY, OCTOBER 11.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—Dr. S. W. Smith: Chairman's Address.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Col. J. W. Gifford: Lenses and Equipment for Ultra-violet Photography.—Dr. H. Boegehold: Some Remarks on Old English Objectives.—T. H. Court and Prof. M. von Rohr: On the Development of Spectacles in London from the End of the Seventeenth Century.

FRIDAY, OCTOBER 12.

DIESEL ENGINE USERS' ASSOCIATION (at 19 Cadogan Gardens, S.W.), at 5.30.—S. B. Freeman: Marine Oil Engines.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. Squirrell: The Use of Instruments in the Boiler-House.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—R. D. Barklie: Alternating Current Electrolysis.—Dr. E. B. Sanigar: Sodium Cyanide in Silver Plating.

SATURDAY, OCTOBER 13.

MINING INSTITUTE OF SCOTLAND (at Glasgow).

PHYSIOLOGICAL SOCIETY (in Physiology Department, Guy's Hospital Medical School).

PUBLIC LECTURES.

THURSDAY, OCTOBER 4.

UNIVERSITY COLLEGE, at 2.30.—Sir Flinders Petrie: History of Decoration.

SATURDAY, OCTOBER 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. R. Ogden: The Recent Discoveries at Ur of the Chaldees.

MONDAY, OCTOBER 8.

UNIVERSITY COLLEGE, at 5.15.—Dr. R. E. M. Wheeler: Recent Work in British Archæology.

WEDNESDAY, OCTOBER 10.

UNIVERSITY COLLEGE, at 5.—Dr. P. Hopkins: The Comparative Psychology of Oriental Religions.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Miss S. M. Fry: Penal Reform (Stevenson Lecture).

SATURDAY, OCTOBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Animal Conquest of the Sea.

CONGRESS.

OCTOBER 9–11.

FRENCH CONGRESS OF LEGAL MEDICINE (at Paris).—Prof. Balthazar: Expert Evidence in Social Questions.—MM. Charbonnel and Masse: Industrial Accidents, Comparative Results of External Methods and Osteosynthesis in the Treatment of Fractures of the Leg.—M. Duvoir: Professional Intoxication by Hydrocarbides.—M. Fribourg-Blanc: Anti-social Reactions in Epidemic Encephalitis.

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SATURDAY, OCTOBER 13, 1928.

CONTENTS.

South Kensington Museums and the Royal Commission.

IT is seldom that the representations of scientific men have been so fully, amply, and speedily justified as in the recent report of the Royal Commission on National Museums and Galleries (Cmd. 3192, 2*s.* net), to which attention was directed in our issue of Sept. 29, p. 465. The present is an interim report dealing "with certain glaring defects of accommodation," and its concluding sentence expresses "the earnest hope that speedy action will follow our specific recommendations on urgent practical matters." These do not involve any question of principle or of policy, with which the Commission will deal in its final report. The growth of the institutions concerned is recognised as having been "severely checked, and economy has already been pushed beyond the point of prudent administration." These are strong words, but the Commissioners are essentially a business body and they issue a business report, admirably weighing the necessity for immediate saving of money as against the economical needs of education. The maintenance of national prestige is emphasised, and this is peculiarly important in these post-War days of increased intercourse by travel. It is not shopping potentialities, sport, or playhouses that primarily attract visitors to our metropolis, but it is historical associations, seen in buildings and design, and it is the importance of its great national collections. Their function is to be spiritually educational, and that this is of real value to practical business life few thinkers are now prepared to deny, while museums pertaining to science teach truths of far-reaching utility to commerce, to production, and to every phase of national life.

The actual proposals that concern us at the moment are mostly connected with biology, but we are glad to observe the recommendation of a small grant to complete the conference room of the Science Museum. This, together with the general tone of the report, we understand means that the Commissioners favour a more active educational policy on the part of the staffs of museums and galleries in making the value and importance of the national collections better known. Particularly in science is "exchange of ideas by personal discussion" of great importance, as the Prince Consort said on the close of the Great Exhibition of 1851. For extensions to the Natural History Museum the recommendation is a grant of £247,500, of which buildings representing £123,500 should be put in

hand at once. This total would have been increased had not the Treasury, through the Empire Marketing Board, previously assigned £30,000 for a building to relieve the congestion in the Entomological Department.

This grant gives practical recognition of the urgent importance to the agriculture of the Empire in the systematised study and identification of the vast mass of insects and other pests of crops and domestic animals. The amount recommended to be expended immediately is £50,000, while the total cost of the whole building is £95,000. Assuming modern methods of construction, this means the addition of an available floor space of about 25,000 square feet, while we venture to think that a properly thought out scheme for fifty or a hundred years would require twice this, namely, the construction of the whole block, and would be cheaper in the end. The further scheme is to replace the unsightly, inconvenient, and unsafe buildings to the north of the Museum by a block the full length of the Museum, of which a quarter would be built at once at a cost of £34,000 for the exhibition and study of whales, an extension of the new spirit building, at a cost of £49,000, replacing the older buildings. Lastly, a reconstruction of the Geological Department at a cost of £20,500, this involving the basement and existing workrooms, will do much to relieve the present congestion, and certainly should precede the building of the east wing, although this is required. Left over as of less immediate importance is the rest of the northern block (£124,000), but we trust that its building will follow.

Correlated with the above scheme is the removal of the Geological Survey and its Museum from Jermyn Street to Exhibition Road, a new home on the north part of the Natural History Museum site with access to both the Science and the Natural History Museums. It is essential that this Museum should maintain its own entity, for it illustrates British stratigraphy and economic aspects of geology, and as such is both the working collection of the Survey and the reference collection of many local collectors from every part of Great Britain. At the same time, its relationship with the Natural History Museum is clear, and the directors of both may be trusted to see that there is harmonious scientific working between their independent institutions. The proposal is financially a 'straddle,' for the value of the Jermyn Street site is estimated to provide the cost of a new building.

We see no proposals as to the oft-debated question whether botanical collections should be maintained both at the Natural History Museum and at Kew. There are such difficulties in amalgamating the two herbaria—and both must be preserved—that there is no likelihood of any saving of public money. Kew is a priceless possession for the plants that are alive; and it has many small museums, mostly economic. At the same time, there is need for an attractive, systematically arranged exhibition of plants, and it should not be beyond the resources of the Natural History Museum to provide this, instead of relegating the Department to attics.

On the whole question of the proper utilisation of museums, the Commissioners show their predilections in reference to the suggested new Museum of Practical Geology: "the proposed arrangement, which provides for less, though better designed display on the exhibition floors and at the same time for greatly improved facilities for storage and study, is in accordance with the best modern ideas of Museum organisation." It is useless to attempt to exhibit every kind of animal and plant. Where it is done, the ordinary visitor is wearied, while the specialist cannot see under a glass case the characters he seeks. Molluscan shells are the boxes containing animals, and corals are the stools of anemones. Birds and other land vertebrates are doubly interesting if exhibited in their natural surroundings, and merely sample skeletons need b[e] shown. All kinds of animals and seaweeds go [to] make up a water environment. Only in a few cas[es] can a museum show lines of evolution or the resul[ts] of heredity. For the rest it is more attractive [to] display exhibits "in a life enhancing way, instead of in the depressing, confusing, fatiguing, and life-diminishing way in which they are now mainly to be seen" (Evidence, p. 303). Show cases can be altered as interest and discovery demands, but this means that a museum must have a staff of artistic technicians, and in this respect the National Museum is deplorably weak. A museum has to teach, an[d] a definite part of the show space must be devote[d] to this end. Only a limited number of the master pieces of creation can be shown; overcrowding [is] psychologically fatal. The public taste can [be] cultivated, and, if the public is not attracted, [let] it be clearly recognised that the exhibits or methods employed are at fault. Why should [not] periodic displays illustrative of the recent adva[nces] and discoveries in biology rival similar exhibit[ions] in the neighbouring Science Museum?

Research is essential, but for this the worker [has] to penetrate to rooms where he can have suita[ble]

light and can handle specimens. He is the person who, by his gifts and published research, has largely made the collections what they are. A museum with such collections, properly named, is the only place where the post-graduate student in systematics can at the present time adequately train himself for research. Large numbers of specimens are requisite, for without them mistakes of fundamental importance will occur. Frequently, the scientific problems that arise can only be solved in the field, and in the future adequate provision will have to be provided, so that members of the staff may study their groups in their natural environments and at the same time collect so as to enrich the National Museum.

The responsibility of science is to see that new museums or additions to old museums are designed wards definite ends. It is certain that systematic collections of all the animals and plants of the world must be deposited and permanently preserved at certain centres, preferably national. hese collections will have to contain a series or at ast several specimens of each species, but to-day t is not beyond the capabilities of science to stimate the requirements even of the National luseum as to space for this purpose. New buildgs should be sectional and easily extensible, their oms so far as possible interchangeable. Well d preferably north lighted research accommodan is essential, and all buildings must be fireoof.

The exhibition galleries of a museum should sent a noble and characteristic frontage and be stically designed, but it is probable that its hive research workers would be more comfortable and icient in factory buildings than in noble halls. e permanent staff of the Natural History Museum totally inadequate for its necessary scientific rk, and science must take care that the money quired for brains is not squandered in bricks and ortar. Some of the evidence leads us to believe at it is possible that some rearrangement of the esent buildings into those suitable for exhibin as apart from study and research would prove t the exhibition space is at present adequate. t us then build for the real needs of science, this would appear to be the views of the missioners, for they have mainly suggested as for what will ultimately be simple interior ildings, not decorative structures. We would come a fuller plan than that presented in their ort.

he Royal Commissioners have begun their task ll, and we look forward to the publication of their full report in a year or two, by which time we trust that what they have recommended as urgent will have been put in hand. They still have many knotty questions to solve, chief of which is perhaps the relationship of the Natural History Museum to museums in many British countries. Clearly its function is to represent the Empire, but the progress of research in each Dominion and Colony requires a systematically arranged collection of its own animals and plants as well as an attractive exhibit to stimulate public interest. Scientific development demands that the ties between all such museums should be drawn close by the freest possible interchange of material. The problem is one that to some degree concerns all galleries and museums, and we trust that the Commissioners will suggest a policy. Clearly, the more the educative and scientific machinery of the Empire can be organised as one whole, the more stable will that Empire become.

Science in Medieval Cipher.

The Cipher of Roger Bacon. By Prof. William Romaine Newbold. Edited with Foreword and Notes by Prof. Roland Grubb Kent. Pp. xxxii + 224 + 38 plates. (Philadelphia: University of Philadelphia Press; London: Oxford University Press, 1928.) 17*s*. net.

IN 1912, Mr. W. M. Voynich discovered in Italy a manuscript entirely written in cipher—a small quarto of 116 leaves, of which eight are missing and some are folded. It measures on the average about nine inches by six. Its history has many gaps, but Mr. Voynich is, we believe, right in his conjecture that it was sold by Dee to the Emperor Rudolph at the close of the sixteenth century, attributing it to Roger Bacon, and that it was probably "the book containing nothing but hieroglyphics" of which Dee's son spoke to Sir Thos. Browne. The usual methods of dating a MS. fail us: the writing cannot be placed, the vellum is coarse for the thirteenth century, but not impossible, the ink is good. Only the drawings remain, and owing to their complete absence of style the difficulty of dating is but increased; it is strange that the draughtsman should have so completely escaped all medieval or Renaissance influences. The cipher has been attacked by several experts in the ordinary methods, and has not yet been read.

It is known that Bacon was interested in ciphers, and made some use of them. A simple one is attached to one of his early works, the "Tractatus

Trium Verborum," the enigma to which attention was directed in our pages on Feb. 11 last being possibly not his work. It has not escaped the attention of Prof. Newbold, who almost correctly transcribes it—"verdhsm menezdhsm Rlierh azdsn ad fratrem Hlgznnc de ozrht Alk"—and remarks that "the words would suggest to any one that *Hlgznunc* is a proper name and that *ozrht* is some attribute or subdivision of alchemy." As a matter of fact, the cipher reads "tercium mendacium Rogeri bacun ad fratrem Johanne[m] de Paris, alkemista." It is a well-known cipher, used in classical times. The words are labelled "Nonsense Words" in the facsimile on Plate IX. (where Nos. 2 and 3 are transposed). So much for a genuine thirteenth-century cipher!

If Prof. Newbold was, however, unable to detect *Paris* in *ozrht*, he was able to find a cipher in places where it had not hitherto been suspected. Sometime before 1254 Bacon wrote an "Epistola de accidentibus senectutis" addressed to Innocent IV. (1243–54). Reading this text, Prof. Newbold "found it difficult to believe that Bacon could have written such confused and clumsy Latin," but on applying the alphabetical process he had devised to it, he discovered (p. 178) that it concealed a letter to Clement IV. (1265–68) containing the date "Sexto mensis Septembris" 1266, a cure for the stone, and a method of producing metallic copper by dry distillation of tartar, common salt, and vitriol. Unusual prescience!

Another early work of Bacon, the "De Mirabili Potestate Artis et Naturae," was subjected to the same process. Chap. x., certainly enigmatical, turns out to be (p. 139) the story of a quarrel in 1273 at Oxford between the "milites" who were studying there, and the "ecclesiasticos." In the course of the story the "milites faciunt salutationem militarem sicut dederunt Cancellario militariter consulenti," and the ancient custom of drinking neat wine and beer on the first of April is alluded to: in short, a farrago of anachronisms of thought, fact, and language.

The connexion of these remarkable results with the Voynich manuscript is that on the last page of the manuscript is found a sentence in Latin broken up by some unintelligible syllables—"michiton oladabas + multos + te + teer cere + portas." Taking the sentence as "michi dabas multas portas," and assuming that its 22 letters were a key to the cipher, an alphabet of 22 letters omitting *k* was obtained. The word 'portas' suggested the 'gates' of the Kabbalah, the combination of the letters of the alphabet, two at a time. This gives 484 symbols. To each of these one or more up to eight letters are assigned. In reading a text, double all but the first and last letters of each word; for example, Incipit = In, nc, ci, ip, pi, it. In = c, t, e, m, n; nc = a, c, e, r; ci = u; ip = e, i, m, n; pi = a, c, r; it = c, i, u. Epistola ep = c, i, r, u; pi = a, c, r; is = i; st = p, i, n, s; to = c, p; ol = c, u; la = m, p; and so on. Setting down these new values in a row, the first letters may be Te; change u into o we get *Teo*, and by selecting values and reversing the order of the next four symbols we get "Teoriac." With this as a clue, a cross-word puzzle mind, a wide range of possible values to choose from, and no restriction whatever as to the order in which the letters of the solution are to be arranged, a fairly intelligible reading of the result is not beyond the powers of a scholar of Prof. Newbold's attainments.

In the cipher manuscript itself there are tw separate fields of inquiry—the writing and th drawing. The only aid to dating the writing come from some half-dozen or so words on the last pag —very slender material indeed on which to form an opinion. One has the impression that they ma conceivably date from the thirteenth or fourteent century, and be perhaps in a north Italian hand The cipher should be readable to experts, ther being 33 pages of it with 1500 or more characters each. Prof. Newbold's theory is quite inadmissibl It is, to take a concrete example, that a letter, long *s* measuring 4·1 mm. in height, is made up 12 distinct significant elements, many of the Greek shorthand characters (Pl. XVIIIA). average height of the short letters is 1·6 mm., these also are decomposed into significant eleme The results obtained from these are in cipher have to be de-coded in the same manner as tho already described. Now, though Greek shorthan had once been known in Byzantine countries, the is not the slightest evidence for its existence in t thirteenth century there, and *a fortiori* in weste Europe. In this particular case, we have remember that medieval ink was not a stain but pigment, that it was applied by a quill, and that dried to a solid; that it was applied to a ha surface not particularly smooth, and thus was lia to crack and flake off. The letter *s* in questio when the photograph is examined with a good in a strong light, seems to show in its descend stem the marks of the quill points, with the between them. (The reproductions in the book useless for the purpose, being half-tone block they should have been collotypes.) Even a pho graph is untrustworthy, as we have the grain of t plate and the grain of the paper for distur

elements when a magnification of 5 to 10 diameters is employed.

The drawings present great difficulty. The only drawing that can be approximately dated (on fo. 74 v.) is not reproduced or mentioned in this book. It represents a cross-bow man wearing a fifteenth-century hat, and is evidently a later insertion since the drawing covers part of an inscription. There are 125 pages of drawings of plants, but apparently not one of them has been identified with certainty, and they bear no relation to the drawings in well-known medieval herbals. The diagrams of an astronomical character have been given explanations more bizarre than the drawings themselves, and those which are thought by Prof. Newbold to be biological are explained by him as representing human ovaries, spermatozoa, cell-division, etc. What they do represent must be left until the cipher is read. Prof. Newbold's account of Bacon's theory of generation is entirely inaccurate—he has lost sight of the meaning of 'matter' and 'form,' and he is wrong in making a distinction (p. 51) between Bacon's theory and Aristotle's, which is shortly stated in the "Physics," ii. c. 3 (194, b, 13), "homo generat hominem et sol" in the words that Bacon knew.

To sum up, the Voynich MS. is an interesting and puzzling piece of pre-Renaissance work, which has baffled the efforts of cipher-readers from Kircher to our own days. Prof. Newbold's suggested solution, with its complicated series of contractions and expansions, is intrinsically unlikely in medieval times and far too dependent on the knowledge and imagination of the decipherer to merit any confidence. It is a first principle that when a writer uses a cipher to conceal a discovery, in all the historical cases known, the concealed text is clear, the surface text involved; here, on the contrary, the surface text is clearer and more grammatical than the one thought to be concealed. The author's honesty and his learning are unquestionable, and some of his results are interesting problems for psychologists. In conclusion, a hearty tribute must be paid to the skill and devotion which have been lavished on the production of this volume by Prof. Kent, who has, as an editor should, entered fully into the mind of Newbold, and has extended and brought together many fragmentary studies on portions of the manuscript. It is to be hoped that Mr. Voynich may find it possible to bring his manuscript to England and make it accessible to specialist students.

ROBERT STEELE.

A Minor Mystery of the Pacific.

Rossel Island: an Ethnological Study. By W. E. Armstrong. Pp. xxviii + 274 + 24 plates. (Cambridge: At the University Press, 1928.) 18*s*. net.

MR. ARMSTRONG is to be congratulated on the solution of one of the minor mysteries of the Pacific, for though Rossel Island lies only some twenty miles north-east of Sudest (Tagula), the intervening reefs make its approach so difficult, that having nothing of value to offer to the trader, its inhabitants were but little known to the white man, while the mental habit of its people, so different from that of the Massim generally, cut them off from those trading voyages which throughout the Louisiade archipelago connect island to island, from the Trobriands and Murua in the north to Tagula in the south-east.

It is true that from time to time Rossel Island has loomed out of its mists and rain squalls as the site of the eating of more than 300 wrecked Chinese coolies in three months, in 1858–59, and to the memory of this great killing, with minor ceremonial acts of cannibalism extending down to the present time, are due most of the occasional visits that have been paid to Rossel by government parties. Our knowledge has thus hitherto been limited to a few official reports, which naturally have dealt mainly with the instant purpose of each visit, though enough of the language was recorded to indicate that this differed profoundly from those spoken elsewhere in the archipelago. There has, indeed, always been a special quality of isolation about Rossel, and even raiders from the more western islands seem to have given it a wide berth. Now, thanks to Mr. Armstrong, we know that though its inhabitants differ in no essential physical character from the other southern Massim, their culture differs profoundly from that of the latter, while both vocabulary and grammar reveal the underlying non-Melanesian quality of the language.

The Islanders are totemic, with descent in the female line, and they resemble the Massim generally in their system of linked totems—bird, plant, fish, snake—though here the plant totem is the most important, while the totem snake becomes a god, and is often regarded as an individual rather than a species; moreover, those snakes that are considered as totems are avoided and feared equally by all clans, irrespective of their totems. The remaining three of the (primary) linked totems scarcely seem to be avoided or respected, though it is probable that a person would not kill or eat the bird totem of his father's clan. Thus, even so well

organised an institution as the 'linked totemism' of south-east Papua has been shaped to play a part in the entirely unexpected structure of Rossel Island religion, which Mr. Armstrong describes as a hierarchy of gods with a supreme deity, known as Wonajö, residing on Mount Rossel. Wonajö created the island but not the race of men, who descend from Mbasi, a god invited to Rossel by Wonajö in order that he might become their progenitor, and it is to Mbasi, not Wonajö, that the origin of many elements of culture is ascribed, for example, the dog, the pig, and taro.

Before Rossel, or the other islands of the Louisiades, existed there was only open sea and reef. The reef which now surrounds Rossel enclosed a large lagoon, the floor of which was Temewe—from one point of view the land of the dead—where there existed an immortal race, whose chief was Wonajö. After untold generations, Wonajö made the land within the reef, and himself repaired to a new home on Mt. Rossel, Ngwö, his abiding place at the present day; though the mysterious island of Loa, at the eastern end of the reef (where many of the ordinary words of the Rossel languages may not be used, and which is rigidly taboo to women), is also regarded as the home of Wonajö to a less degree only than Ngwö.

After creating the land, Wonajö made the clouds and the stars, but not the sun and the moon, and the clouds that almost perpetually cover Rossel are the ashes of the first fire, which he threw up into the sky to conceal the island from the older island of Sudest.

Wonajö and his people are considered to have existed in human form in Temewe, but on Rossel he takes the form of a snake by day, to reassume his human form at night. Most of the gods have this double character, alternating in form between the human and snake, though certain of their company take the shape of other animals, and many are normally stones. In their snake form the gods are dangerous to man, and are supposed to become of enormous size, and to swallow any human being who has the temerity to approach the sacred places in which they exist.

Such sacred places are many of the shrines and areas called *yaba*. Each is concerned with some object or principle, and often contains a stone which represents the substance or quality with which the *yaba* deals, for example, the original bundle of sago hidden by Wonajö is now a stone in the sago *yaba*. Moreover, "since every god is associated with a *yaba*, and many of the gods are, in a certain sense, the totems of clans, we should expect a division of religious function amongst the clans and an association of clans with particular *yaba*. This, in a general way, is certainly the case, but I was unable to prove that a given *yaba* is always either possessed by or controlled by the appropriate clan, though this may be the case. It was, however, fairly clear that the gods are of equal importance to all the clans, and a given god is neither particularly favourable to nor favoured by the clan totemically associated with his *yaba*."

Mr. Armstrong gives a long list of *yaba*, which, if in the highest degree dangerous if neglected or rashly trespassed upon, are also the shrines at which correct treatment or ceremonial ensures the well-being—each more or less rigidly in its own special sphere—of the people. "The universe is like a machine, with a few exposed parts, which, so long as they are kept clean, ensure the smooth working of the whole. That is the chief religious duty of man; but the machine requires oiling at times, and we find that this is a more positive duty of the priests of certain of the more important of the *yaba* that give a beneficent reaction."

The extraordinarily complex monetary system of the island takes nearly thirty pages to explain. Its complications permit of no more than the mention of its existence in a review such as this.

The volume begins with an admirable introduction by Dr. Haddon, wherein are assembled and considered the available data concerning the physical characters of the Massim, and there are appendices by Mr. Armstrong, giving (1) a full history of and bibliography of the island, (2) account of the physical measurements of its inhabitants, and (3) an essay on the general theory of the classificatory system of relationship.

To sum up: this work, though not to be regarded as the final monograph on Rossel, constitutes an important and long-desired addition to our knowledge of Melanesia.

C. G. S.

A Critic of Modern Biology.

Modern Biology: a Review of the Principal Phenomena of Animal Life in relation to Modern Concepts and Theories. By J. T. Cunningham. Pp. xii + 244. (London: Kegan Paul and Co., Ltd., 1928.) 10*s*. 6*d*. net.

THAT the modern fashions of biochemistry and genetical study have resulted in most valuable contributions to that rather incoherent mass of knowledge which we call biology will be denied by no one; that these methods have severe limitation is not perhaps so clearly realised. Mr. Cunningham

vhose marked independence of mind is known and 'alued, has in this book applied a keen logical ntelligence to the theories and concepts arising out of these new disciplines, and has brought out some of their obvious limitations. His aim has been to est the validity of these modern views by applying hem to the fundamental questions of biology in order to see whether they supply satisfactory answers.

While Mr. Cunningham accepts a good part of the gene hypothesis as solidly based on fact, he is by no neans inclined to swallow the mutation-selectionist view which is offered by the Morgan school as a sufficient explanation of adaptation and evolution. He considers that the sort of facts established by he study of Mendelian inheritance are of a different order and of minor significance as compared with hose that constitute the major problems of adaptaion, recapitulation, functional development, and he like. For these a different kind of explanation s required, and is in the main still to seek.

Mr. Cunningham is equally critical of the claims of biochemistry. He roundly asserts that "biochemists have no true conception of the problem of ife at all, because they have approached the subject from the chemical point of view and have not studied living organisms from any other point of view. It is very probable, if not absolutely certain, that life is a phenomenon which is altogether lifferent from the chemico-physical processes which ake place both inside and outside the organism. Biochemistry and physiology in the ordinary edical sense treat the organism as an engine in tion at a given moment without regard to the past or future of the organism" (p. 9). Biology is not, and can never become, merely comparative biochemistry.

These are the main critical themes of the book, and they are developed with much knowledge, fairness, and acuteness of judgment. For this alone the book deserves careful study, especially by those whose enthusiasm for 'some new thing' leads them to uncritical acceptance of the latest octrines.

However, there is also a constructive side to Mr. Cunningham's book. He develops in an interesting way the modern Lamarckian theory which he has lready outlined in 1908 and in his "Hormones and Heredity" (1921). In this connexion he gives a nost useful critical account of modern work on he transmission of acquired characters. Though himself convinced that without such transmission evolution is inexplicable, Mr. Cunningham does not llow this belief to mitigate the severity of his analysis of the evidence recently adduced in favour of this transmission, notably by Tornier and Kammerer. Particularly interesting is his account of McDougall's experiments on the inheritance of acquired habits in rats.

In the concluding chapter, Mr. Cunningham sketches, but unfortunately does not elaborate, his own philosophical position. It is one with which the present reviewer, at any rate, has much sympathy. In Mr. Cunningham's view life is coterminous with some degree of mind or consciousness. "The principle of continuity applies here as elsewhere in evolution, and so far as I can see, there is no possibility of separating life and consciousness. The difference between the 'mind' of an earthworm or an amoeba and of a man may be very great, that of an earth-worm is merely a potentiality rather than an actuality, but the difference must logically be regarded as a difference of degree, not a difference of kind. In this sense even plants may be considered to have the rudiment or potentiality of consciousness and mind" (p. 225).

It is true that for the purposes of science we may regard the organism purely objectively, and abstract from its psychical aspect, but in so doing we are artificially limiting the scope of biology and pursuing the phantom of a complete physico-chemical explanation of the living thing. Mr. Cunningham, while rejecting any dualism of body and mind, is a vitalist in the sense that he regards the living organism as being, if a mechanism at all, then a mechanism "essentially different from any inorganic, non-living mechanism." The truth seems to be that 'mechanism' is a more abstract concept than 'organism,' and while it may be very useful in biological research, as events have shown, it is inadequate when we come to tackle the major problems of development and evolution.

E. S. R.

Fundamental Principles of Radio Communication.

Principles of Radio Communication. By Prof. John H. Morecroft, assisted by A. Pinto and Prof. W. A. Curry. Second edition, thoroughly revised. Pp. xiv + 1001. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 37*s.* 6*d.* net.

The science and practice of radio communication have developed so rapidly during the past ten or fifteen years, and now cover such a wide field, that it has become impossible to confine an adequate technical description of the subject within

the covers of a single volume. Whatever alteration may take place on the practical engineering side, however, it is unlikely that the fundamental principles of the generation, transmission, and reception of electromagnetic waves will be materially changed; and it is with such principles that the somewhat formidable volume compiled by Prof. Morecroft is concerned. It is the second edition of a book with which many radio engineers are already familiar; and although, as mentioned in the preface, two chapters from the first edition have been deleted and a third has been considerably reduced in length, the amount of new material dealt with is such as to bring the present volume up to just above one thousand pages. The newcomer to the wireless art will probably be appalled by the size of the volume, but there is no doubt that the serious student and the technical engineer will find the book a mine of information and an extremely useful text-book.

The first chapter of the book deals with "Fundamental Ideas and Laws," and leads the reader quickly but firmly from the electron up to the properties of alternating currents, with their associated circuits either alone or coupled together. Many illustrations are given of alternating current and transient phenomena with the aid of oscillograms taken at frequencies of the order of sixty cycles per second. Chap. ii. is devoted to a detailed consideration of those most important electrical quantities, resistance, inductance, and capacity. The utility of this chapter is considerably enhanced by the inclusion of many formulæ and tables for the calculation of these quantities in practical wireless circuits. It is interesting to note here that in connexion with mutual induction and screening, the author is clearly under no misunderstanding as to the relationship existing between electric and magnetic fields. After the above introduction the student is taken in the third chapter into a study of the oscillatory circuit, which is fundamental to either transmission or reception in radio.

For some reason which is not quite clear, a description of the various types of antennæ by means of which the oscillatory currents are converted into electromagnetic waves is delayed for several chapters. The fourth chapter assumes the generation of such waves and describes briefly the main phenomena met with in the propagation of waves over the earth's surface. This chapter is all too short for the subject and most of the important English work carried out since 1921 is omitted; but we must neither forget the title of the book nor its present size. The propagation of electromagnetic waves is nowadays more suitable for treatment in a separate monograph.

After devoting about seventy-five pages to spark transmitters, the thermionic vacuum tube receives very full consideration, first as a general treatment of the theory and operation of valves of various types, and then later in connexion with a description of the circuit arrangements and performance of different kinds of valve amplifiers at both audio and radio frequencies. Here oscillograms are again reproduced as illustrating such points as grid rectification and the effect of grid bias on distortion. The various modes of producing undamped oscillations for continuous-wave telegraphy are dealt with in Chap. vii., while the following chapter describes the means employed for modulating such oscillations and applying them to radio-telephony and broadcasting. As already mentioned, a later section of the book is devoted to a description of the various types of antennæ used in practice, with the means of calculating the radiation from them. The transient oscillations set up in an antenna when a pulse is applied thereto are illustrated with further oscillograms, and a brief consideration is given to loop antennæ and their application to direction-finding.

Altogether the author has carried out his somewhat arduous task in a very satisfactory manner, and has provided a most useful book of reference which should be available to every serious technical worker in the field of radio communication. In perusing the book, very few misprints have been noticed, and the work is both written and produced in a most satisfactory manner.

R. L. SMITH-ROSE.

Our Bookshelf.

The Principles of Electric Power Transmission by Alternating Currents. By H. Waddicor. Pp. xix + 399. (London: Chapman and Hall, Ltd., 1928.) 21s. net.

THIS book is intended for engineering students and for electrical engineers who are engaged in transmission and design. All the matters discussed are directly useful to engineers. Since Faraday and Henry discovered magnetic induction, the theory of the transformer has strongly attracted mathematical scientific men. In our opinion there has been very little true theoretical progress since Maxwell gave the theory of the air core transformer in 1865. Fleming has expanded this theory and given it in a form which can be easily understood. When, however, attempts are made to take hysteresis and eddy currents into account, we have to fall back on approximate formulæ, and in most cases we are ignorant of their limitations.

Although it is difficult to deduce formulæ for the iron core transformer from formulæ for the air core transformer, the converse operation is always possible, and if the results do not come out correctly, then there must be something wrong with the formulæ being tested. In this book the limitations of the theories are rarely stated. This makes progress rapid, but must sooner or later cause difficulties to engineers using the formulæ. For example, the statement that if we add to the resistance of the primary n^2R_2, where R_2 is the resistance of the secondary and n is the ratio of the secondary to the primary current, we get the true effective resistance of the transformer on the primary side, is true for the air core transformer. But students have a difficulty in believing that the ratio n is a constant, seeing that it is zero on open circuit.

Great stress is very properly laid on making the sum of the cost of the operating losses and the overhead charges in dollars per annum a minimum, but some of the mathematical equations given, as, for example, on p. 95, we have quite failed to understand. Although we think that the methods of obtaining the formulæ used in practice given in the book could be very considerably improved, it contains much valuable information for engineers.

Bestimmung, Vererbung und Verteilung des Geschlechtes bei den höheren Pflanzen. Von C. Correns. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Lieferung 3 (II. c), Band 2.) Pp. iv + 138. (Berlin: Gebrüder Borntraeger, 1928.) 19·20 gold marks.

THE genetics of sex in plants is probably more complicated than in animals. It is even doubtful how far sex phenomena are comparable in the two kingdoms. Certainly they have diversified along different lines with the greater individual unity and specialisation in the higher animals as contrasted with the less clearly defined individuality of the higher plants, which have often the power of vegetative multiplication in addition to, or even almost replacing, sexual reproduction. It is only a few years since sex chromosomes were discovered in seed-bearing plants, and the unsolved problems of 'sex' in the Cryptogams and in hermaphrodite, monœcious, and polygamous Phanerogams are manifold.

A summary of the present position of our knowledge of sex in plants by a pioneer and recognised authority on this subject is of considerable importance. Prof. Correns does not deal with plants lower than Bryophytes. Utilising Blakeslee's terminology of homo- and heterothallic types for the diploid phase, he is able to divide his subject under four main headings. Attention has lately been concentrated on more or less completely diœcious flowering plants, and though even amongst them complications appear in different genera and species, a useful attempt has been made in this work to reduce all the examples known in sufficient detail to two generalised schemes. The work is illustrated by 77 text-figures (including diagrams) and has references to literature occupying 9 pages. An ample list of contents is provided but there is no index.

The Modern Calorimeter. By Dr. Walter P. White. (American Chemical Society Monograph Series, No. 42.) Pp. 194. (New York: The Chemical Catalog Co., Inc., 1928.) 4 dollars.

ALTHOUGH it is written essentially for the specialist in calorimetry, this book is arranged in such a way as to be equally valuable to the general scientific reader. Dr. White has made important contributions to recent developments of calorimetry, and while his book does not completely cover the whole field, it gives a good account of the numerous practical details necessary in obtaining reliable estimates of accuracy. The author remarks that "calorimetric processes depend on temperature distributions and heat flows; things invisible, hard to measure or control with exactness," and he has therefore endeavoured to show the value of systematic calculations involving accurate estimates of the precision and reliability of the various methods and apparatus employed.

The book deals with fundamental processes and measurements, particular methods and particular apparatus, and calorimeter design and the planning of installations. The author refers to it as "an experiment," and it must be voted a successful one.

(1) *The Life of the Spider.* By J. Henri Fabre. Translated by Alexander Teixeira de Mattos. With a Preface by Maurice Maeterlinck. (People's Library.) Pp. xxxi + 288. (London: Hodder and Stoughton, Ltd., n.d.) 2*s*. 6*d*. net.

(2) *The Spoilers.* By J. Henri Fabre. Translated by J. E. Michell. Pp. 287. (London: Hodder and Stoughton, Ltd., n.d.) 7*s*. 6*d*. net.

THE first mentioned of these two volumes consists of translations of articles from Fabre's "Souvenirs entomologiques," dealing with the life of spiders, and with the exception of Chapter ii., none has previously appeared in English. The second volume, "The Spoilers," is written in the form of dialogue between a benevolent informer and his pupils: various kinds of injurious and other insects are discussed in a conversational manner, moths and beetles coming in for the largest share. The translations of both books are well done, and they should interest the growing body of readers to whom popular writings on insect life make an appeal.

Le grandi industrie chimiche. Gli acidi inorganici: solforico, nitrico, cloridrico; fabbricazione, macchinarie, impianti. Per Dott. Antonio Aiti e Prof. Henry Molinari. Pp. xv + 472. (Milano: Ulrico Hoepli, 1928.) 48 lire.

AITI and Molinari's work gives an account of the actual position of the mineral acid industry which usefully supplements the existing treatises, since it deals with many processes which are not adequately described in the standard works on the subject. It is a valuable addition to the literature of chemical technology.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Markings on Diatoms and Resolving Power of Microscopes.

AT various times there has been discussion as to the actual nature of the markings on the valves of diatoms—whether pits, projections, or perforations.

Any image formed by a microscope of objects the dimensions of which are not large compared to the

(*a*) (*b*) (*c*)

FIG. 1.—(*a*) Diatom (from New Zealand), diameter 0·004 inch, magnification 150; photograph taken with $\frac{1}{12}$ immersion objective; (*b*) part of *a* enlarged, magnification 900; (*c*) similar enlargement of a negative taken under the same conditions as *a*, but with the objective $\frac{1}{25000}$ in. closer to the diatom.

wave-length of light, should be considered rather as phenomena the meaning of which has to be interpreted than mere magnified copies of the objects in the field. This is true even when the objects are quite thin and flat, but when the thickness is variable, the appearance of the image changes very rapidly as the focal plane is made to approach or recede from the uneven surface.

This is well illustrated in Fig. 1, *a*, *b*, and *c*: *a* is a photograph of a New Zealand diatom, magnification 150, taken with a $\frac{1}{12}$ immersion objective. The diameter of the disc is 0·004 in. and the dots are separated by $\frac{1}{8000}$ in.; *b* is an enlargement of part of *a* (magnification 900); *c* a similar enlargement from a

(*a*) (*b*) (*c*)

FIG. 2.—(*a*) Photograph of a piece of perforated zinc; (*b*) photograph from an enlarged copy of *a* on a thick bichromate film of gelatine, the focal plane of the enlarging lens being about $\frac{1}{4}$ in. from the summit of the gelatine bosses; (*c*) similar enlargement of gelatine print, the focal plane of the enlarging lens being coincident with the floor of the depression between the bosses.

negative taken in the same condition as *a*, but with the focal plane $\frac{1}{25000}$ in. closer to the slide. In Fig. 1, *b*, the dots appear as bright circular patches, while in Fig. 1, *c*, the dots are dark and are separated by well-marked hexagonal boundaries.

These appearances can be explained if the surface of the valve is supported or covered with convex bosses separated by troughs with somewhat rounded cross-sections. The bosses act as condensers, and when the focal plane of the objective approaches that of the bosses, the latter show bright images of the source of light.

Of course, no very good image can be produced by a lens the diameter of which is only two or three wave-lengths, but the bosses do produce some concentration of the rays passing through them, and the size of the bright patch focused by the microscope varies with the distance between the focal plane of the objective and the approximate focus of the bosses.

In Fig. 1, *c*, the focal plane of the microscope coincides with the floor of the valleys separating the bosses, and what is photographed is the virtual image formed by the concave trough with some of the dependent diffraction bands.

For the sake of comparison, a surface similar to that assumed for the diatom valve, but on a large scale, was prepared by photographing a piece of perforated zinc (Fig. 2, *a*) and printing this on a thick film of bichromated gelatine. The bichromate was removed by soaking in cold water, and the plate was then placed for some time in a fairly strong solution of glycerine, and allowed to drain. In this way the unaltered swollen gelatine remained as convex bosses, which, though rather flat on top, yielded results very similar to that obtained from the diatom. Photographs corresponding to *b* and *c* of Fig. 1 are given in *b* and *c* of Fig. 2. The marking on such diatoms as *P. Angulatum* or *A. pellucida* differ probably from the coarser form only in scale.

I remember seeing at one of the Royal Society's soirées a photograph of *A. pellucida* taken by ultra-violet light with quartz lenses, which might very well have been supposed to represent a piece of perforated zinc. In 1879, Messrs. Powell and Lealand showed me *A. pellucida* under a $\frac{1}{25}$ immersion lens, and here the valve appeared covered with parallel lines so well defined that it seemed that several more lines might have been inserted between them. A small alteration of adjustment, however, changed the direction of the apparent lines, and in one condition the two series were both visible, their intersection suggesting dots.

The late Lord Rayleigh was, I believe, the first to point out that the resolving power of a lens (which may be defined as the least distance which must separate two objects if their images are also to appear separated) depends on the difference of the optical length of the rays from the objects to their respective images. If this difference does not exceed a quarter of a wave-length at least, there will be no real separation; and for complete separation a difference of not less than a half wave-length is requisite. This statement applies to all optical instruments, but the appearances in the field depend in a great measure on the illumination; whether, for example, the objects are self-luminous like stars, or obtain the light by which they are seen from a common source, in which case there is a phasic relation between the waves in each ray.

Microscopists seem to have an exaggerated idea of the resolving power of their lenses. With an object consisting of alternate opaque and transparent lines on a plane film very thin compared with the wave-length[1] no objective (no matter what its numerous apertures might be, or what form of illumination was employed) could separate the lines if their spacing was much less than a whole wave-length. In *A. pellucida* the spacing is about half a wave-length, and the fact that their resolution is readily effected in ordinary light shows that the surface of the valve is uneven. A difference of elevation of a two-hundred-thousandth of an inch between the hills and valleys would allow ridges or dots to be distinguished, while if the surface were plane they would be quite unrecognisable.

A. MALLOCK.

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[1] The only test plates in which, so far as I know, these conditions are approached, are those which I ruled on films of methyl violet. The film in question varies from a tenth to a thirtieth of a wave-length in thickness.

A Method of Preparing Sections of Fossil Plants contained in Coal Balls or in other Types of Petrifaction.

THE method described in this letter was devised in collaboration with Dr. R. G. Koopmans of Utrecht. A flat surface must first of all be cut or ground on the coal ball or other petrified mass parallel to the planes in which the sections are required: this surface is ground smooth, but a fine polish is not necessary. The surface is then immersed for a definite length of time in an etching solution of hydrochloric acid, the optimum concentration being found by trial. The acid dissolves away a film of the carbonate of which the mass is largely composed, and the plant substance contained in the film is left behind, standing in relief above the surface. The surface is washed carefully and dried. A solution or fluid, which on drying or hardening forms a tough film, is then poured over the surface and allowed to dry or harden. Several solutions have been used for this purpose; the best as regards consistency is the trade preparation 'Durofix,' but other solutions containing cellulose compounds may be used. When quite hard this film of cellulose-compound may be peeled off, as it has considerable tensile strength. The plant substance which was left in relief by the etching process is embedded in the film and is detached with it from the surface of the petrifaction. The film is then washed, first in the acid and then in water, dried, cleared, and finally mounted in Canada balsam between a slide and coverslip. The surface of the petrified mass is gently rubbed down on fine carborundum paper and is then ready for the removal of another section.

These sections consisting of the plant substance embedded in a film of cellulose compound are scarcely distinguishable from good petrological slices cut from the petrified mass direct, and are usually much superior. The thickness of the plant section depends on the length of exposure to the acid bath, and may be of a very small order if so desired. The sections are of uniform thickness and are almost unbreakable. From the botanical point of view, the main advantage of the new method is that almost continuous serial sections may be prepared, since the old method of cutting petrological slices allowed at the most three sections to five millimetres of material. The sizes of the films are limited only by the size of the petrified mass from which they are made. When a petrifaction contains several different objects, it may be convenient to cut up the films with scissors and mount the parts separately. The cost of making a film is negligible compared with the cost of preparing a petrological slice, which involves in its production a considerable amount of hand labour. With silicified material hydrofluoric acid must be used instead of hydrochloric.

No attempt has yet been made to apply the method to plants preserved in pyrites, but here again a suitable acid must be chosen to dissolve the pyrite.

JOHN WALTON.

Department of Botany,
University of Birmingham.

Condition of Radium Salts after Storage in Sealed Glass Tubes.

IT has recently been found necessary in the Government Laboratory to open and subdivide two tubes containing radium salts which were sealed by us in 1921, and it is thought that the experience gained in opening them may be of interest to others working with radium preparations of high grade.

The tubes contained 171·8 and 54·9 milligrams of radium element as 92 per cent chloride and 50 per cent bromide respectively. These salts had been dried at 240° C. for two hours before they were sealed into thin glass tubes, each furnished with a small piece of fine platinum wire fused into it.

To open the tubes a method believed to have been devised by the late Mr. Harrison Glew was used. Each was placed in a clean lead tube such as is used to contain tooth-paste, and the lead folded down on the glass. By applying pressure with a screw jaw spanner the radium tube was then cracked, whereupon the lead tube was slit with scissors and the radium salt washed out.

We had been led by other workers to expect that there would be a considerable gas pressure in the tubes, arising from the decomposition of water, but no sign of this was observed, as, for example, by distension of the tube. The glass of the tubes, although strongly coloured, showed no apparent disintegration or deterioration from the action of the rays. It may be concluded, therefore, that considerable quantities of high grade radium salts, sealed in glass tubes, can safely be kept unopened for periods of at least seven years, provided the drying has been thorough.

The effect of the action of the radium on the labels and packing may be mentioned. Thus on evaporating the filtered radium solutions a gummy organic impurity was observed, apparently produced under the action of the rays from the paper labels on the tubes and from cotton-wool packing. The cotton had completely disintegrated, some traces only adhering to the tubes. It has been observed in this laboratory that when cellulose is exposed to β and γ rays in presence of air, it is chemically altered, the proportion of material soluble in 3 per cent caustic soda solution notably increasing. It would thus seem advisable to avoid attaching any label or other foreign material directly to the glass of tubes containing radium, and to store the tubes out of contact with organic matter.

Two further points may be mentioned as regards recovery. To purify the contaminated radium, it was ignited at a faint red heat in silica dishes. After this treatment the dishes were found to be distinctly radioactive, and upon treatment with hydrofluoric acid four dishes yielded 0·3 milligram of radium which had not been removed by means of hydrochloric or hydrobromic acid.

Finally, it may be mentioned that more than 98·5 per cent of the radium salt, after it had been kept in a sealed glass tube for seven years, was still in a state soluble in dilute acid.

A. G. FRANCIS.
A. T. PARSONS.

Government Laboratory,
Clement's Inn Passage,
Strand, W.C.2,
Sept. 24.

The Crystal Structure of Solid Methane.

IN view of the recent controversy concerning the structure of the methane molecule, it is proposed to state briefly the results of an X-ray 'powder' investigation of solid methane at a temperature intermediate between that of liquid air and liquid hydrogen.

Only one modification, a cubic one, was found, and the observed spacings indicated a structure based upon a face-centred lattice, the unit cell having an edge 6·35 A. and containing 4 molecules of methane. (This gives, for solid methane, a density of 0·413 gm./c.c., while that of liquid methane at its boiling-point, − 164° C., has been given as 0·415 gm./c.c.)

There are no abnormal spacings except those characteristic of a face-centred lattice, hence the

possible space-groups are: T^2, T^2_h, T^2_d, O^3, O^5_h. Of these, if it is assumed that all the carbon atoms are crystallographically identical, and that all the hydrogen atoms are identical in this sense, only T^2 and T^2_d give 4 equivalent positions for the carbons and 16 equivalent positions for the hydrogens, but it is extremely doubtful whether this restriction can be applied, on account of the uncertainty concerning the symmetry of the hydrogen atoms in the well-known ammonium chloride structure. However, if this restriction is permissible, the symmetry of the carbon atom in solid methane is evidently either T or T_d.

Assuming as a first approximation that the carbon atoms are alone responsible for the scattering, a very satisfactory agreement between the observed and calculated intensities of reflection from the various planes (taking into account in the latter the Ponte reflecting power factor for the carbon atom in addition to the usual factors) is obtained. The question of intensities will be fully discussed later in a more complete account of the work.

Weissenberg has recently concluded from theoretical considerations that among substances of the type Ca_4 there is no reason why electrically symmetrical molecules (representing a tetrahedral structure) should not occur just as frequently as molecules with dipoles (pyramidal structure), hence the tetrahedral structure for solid methane demanded by the results of this research is evidently not in disagreement with the most recent theoretical conclusions on the subject.

J. C. McLennan.
W. G. Plummer.

Physics Building,
University of Toronto, Sept. 20.

The Period of Human Gestation.

There is perhaps no problem of greater human interest than that of the factors which govern the duration of pregnancy and the onset of parturition, and any new information bearing upon the mechanism involved is of profound interest, not only to the gynæcologist and obstetrician, but also to biologists in general, and to the layman in particular.

No apology is necessary, therefore, for bringing to the attention of a wider scientific circle the important contribution by Prof. W. A. Jolly, of the University of Cape Town, in the *Journal of Obstetrics of the British Empire*, vol. 35, No. 2, "On the Period of Human Gestation." Collaborating with his colleagues, and presumably by observations on European women, Prof. Jolly has brought forward a considerable body of evidence to demonstrate at least one cause of the fluctuations in duration of the gestatory period in human beings. Recognising the fundamental physiological comparison between the menstrual and gestatory phenomena, he has shown:

(1) That the period of human gestation is intimately related to the length of the mother's menstrual cycle in any particular case.

(2) That the physiological period of gestation extends customarily over eleven cycles, counting from the middle day of the last menstrual flow, and not ten cycles as is currently assumed.

(3) That this law holds good in pregnancies in which the maternal cycle is short. When the cycle is of 24 days and regular, the pregnancy, counting from the last menstrual flow, lasts for 264 days (that is, 11 cycles). In 26-day-cycle cases, the pregnancy lasts for 286 days.

(4) That in long-cycle cases—27 days and upwards—the law is commonly modified by a complication resulting from the age of the fœtus, and birth is likely to take place when the tenth missed period following conception falls due, or shortly thereafter.

The extension of Prof. Jolly's observations and deductions for human beings of different races by obstetricians, and the application of the underlying physiological principle to comparative embryology by zoologists, presents a wide field for future scientific investigation.

Raymond A. Dart.

Medical School,
University of the Witwatersrand,
Johannesburg, Sept. 8.

The Daily Terrestrial Magnetic Variations; and the Sun's Magnetic Field.

R. Gunn has recently suggested (*Physical Review*, July 1928) that the daily variation of the earth's magnetic field is due to the diamagnetism of the outermost layer of the atmosphere, where the ions and electrons can freely spiral many times round the lines of the earth's magnetic field between collisions; their circular motion renders them equivalent to small magnets directed opposite to the field. The magnetic effect is, however, far outweighed by that of a drift acquired by the charges under the joint action of the magnetic field, gravity, and the vertical electrostatic field which prevents the light electrons from spreading upwards much farther than the heavier ions.

The drift is westward for the electrons and eastward for positive ions; it therefore constitutes an eastward current. The magnetic field of the drift currents, which are stronger over the sunlit than over the dark hemisphere, is similar to that due to the diamagnetism of the same outer layer, but greatly exceeds it in intensity; both are very similar to the observed field of the daily magnetic variations. It does not seem possible as yet to decide whether the latter are caused mainly by the drift-currents in the outer layer, or by dynamo action in the conducting layer below. The outer layer, though highly ionised, is almost non-conducting, as P. O. Pedersen has pointed out ("The Propagation of Radio Waves," Copenhagen, 1927); this is because a force F, acting on a charge in a magnetic field H, produces no mean motion in its own direction, but only a transverse drift, normal to F and H.

The drift-currents seem capable also of explaining the rapid outward decrease of intensity in the sun's magnetic field, and may play a part in the magnetic field of sunspots. The initiation of the general solar field and the sunspot fields has to be explained by separate hypotheses. Details of these and other cognate results will shortly be given elsewhere.

S. Chapman.

Imperial College of Science,
South Kensington, S.W.7,
Sept. 21.

The Presence of *Phlebotomus chinensis* in Syria.

Recently the Kala-Azar Commission of the Royal Society implicated *Phlebotomus chinensis* as a carrier of kala-azar in Northern China. The distribution of this sandfly is therefore a matter of the very greatest importance. Hitherto it has been found only in Northern China and in the Himalayas.

Among sandflies collected by us in Aleppo in Syria, about one per cent were found to be *Phlebotomus chinensis*. It is therefore to be expected that *P. chinensis* has a wide and continuous range of distribution from Northern China to Asia Minor and Syria. Kala-azar is present in Turkestan and Transcaucasia and has recently been reported from Syria.

P. chinensis has until recently been considered a ariety of *P. major* (syn. *P. perniciosus*), which it sembles externally. This classification was due to ie fact that the external male genitalia (which are ery similar in *P. major* and *P. chinensis*) were onsidered to be of specific value, a view which, in he light of recent researches, is no longer tenable, nd to the fact that until quite recently no characters ere known which could be used for the identification f females.

The Kala-Azar Commission of the Royal Society *Proc. Roy. Soc.*, B, vol. 102; 1928) made *P. major* ar. *chinensis* a subspecies on the character of the permathecæ. We consider *P. chinensis* to be an ndependent species, for the spermathecæ and the harynx in the female and the pharynx in the male how constant and very marked differences from those f *P. major*.

The diagnosis of sandflies in the Mediterranean egion has hitherto been based only on the character f the male genitalia, a character which cannot istinguish *P. major* from *P. chinensis*. Further search based on the characters of the spermathecæ nd the pharynx is therefore necessary to determine ther *P. chinensis* is present in the kala-azar areas and the Mediterranean from which *P. major* has en recorded.

If, as we think probable, *P. chinensis* will be scovered in these areas, new light might be thrown the epidemiology of kala-azar in the Mediterranean gion.

S. Adler.
O. Theodor.

Microbiological Institute,
Hebrew University,
Jerusalem, Sept. 17.

The Dissociation of Pure Mercury.

By applying Sommerfeld's expression (*Zeit. für ysik*, **47**, p. 1; 1928) for the conductivity σ of a metal

$$\frac{8\pi}{3}\frac{e^2 l}{h}\cdot\left(\frac{3n}{8\pi}\right)^{\frac{2}{3}}$$

he conductivities of dilute amalgams, it is possible alculate n for pure mercury without a knowledge e is the charge and l the M.F.P. of an electron, number of electrons per c.c.

Let there be c atoms of the metal X per atom of rcury. If both X and mercury are divalent, and both mpletely ionised, $\sigma=\sigma_0(1+c)^{\frac{2}{3}}=\sigma_0(1+\frac{2}{3}c-\frac{1}{9}c^2\ \ldots\ .)$, s equation is of the form obtained experimentally cadmium amalgam, but the coefficients disagree. lliams gives for cadmium at 14° C. (*Phil. Mag.*, **50**, 599; 1925) $\sigma=\sigma_0\,(1+4{\cdot}37c-6{\cdot}27c^2)$.

The two expressions can be reconciled by assuming at only a fraction q of the mercury is ionised. Then $\frac{2}{3}q=4{\cdot}37$, $q=0{\cdot}15$, a value confirmed by that obtained m the second coefficient; $1/9q^2=6{\cdot}27$, $q=0{\cdot}13$.

Compound formation, and incomplete ionisation of solved metal aggravate the discrepancy, so that value given for q is a maximum. Specific effects not, however, greatly influence the conductivities those dilute amalgams for which σ increases with c, is seen from the values of the coefficient of c: cadum, 4·37; zinc, 4·78; magnesium, 6·18. The lue for zinc is calculated from Larsen's results *nn. Physik*, **4**, I. p. 126; 1900).

A density correction may be introduced. If M is molecular weight of X, d the density of the algam, d_0 that of pure mercury,

$$\frac{n}{n_0}=\frac{1+c/q}{1+\dfrac{Mc}{200{\cdot}6}}\,\frac{d}{d_0}.$$

Hence observed values of σ must be corrected by multiplication by

$$\left[\left(1+\frac{Mc}{200{\cdot}6}\right)\frac{d_0}{d}\right]^{\frac{2}{3}}.$$

Using Richards and Forbes's values for d (Carnegie, Inst. Pub., 56) at 20° C.—the slope of the d/c curve is probably but slightly affected by small temperature changes—we obtain for cadmium amalgams $q=0{\cdot}13$; for zinc amalgams $q=0{\cdot}12$.

R. S. Bradley.

The University, Leeds.

Unit of Acceleration.

Referring to Mr. Keeping's letter on p. 478 of Nature of Sept. 29, I agree that learners of the elements would be helped by a handier specification for acceleration; but a name for unit velocity would suffice. Speed is a primary apprehension, and it is rather odd that no unit name has been chosen for it; except 'knot.' Suppose for a moment that the velocity unit were called a 'vel'; then acceleration would be in vels per second, and momentum in gram-vels or pound-vels. These are not hopelessly bad: context would show whether feet or centimetres were intended; in any serious non-teaching specification abbreviations are seldom permissible.

Too many fanciful and slang names are undesirable: they were essential in electrical engineering because the real nature of the phenomena were and are unknown, so ohms and volts and amperes have proved invaluable. We are now beginning to think that the real nature of mechanical quantities is unknown too, but anyway we are accustomed to them, which is what we mean by understanding; so their units should not be named on the same plan as electrical units, by appropriation of great names. Watt and Joule, and perhaps Gauss, were fortunate in having monosyllabic names, but 'Gal' would be disrespectful. 'Erg' and 'dyne' have proved fairly serviceable, and any further mechanical unit should be named on that plan if it is to be international. 'Vel' happens to be suggestive and intelligible in several languages.

Oliver Lodge.

Sept. 30.

Geological Jargonese.

In some of the elementary books used in learning languages, a short glossary of difficult words is set at the head of each exercise. Will you not follow this practice in your technical articles and reviews? A recent obviously brilliant notice of a geological work of surpassing interest—on partition of the continents—is practically Chinese to us unfortunates who learnt our little geology in days when Lyell and Geikie were current and could be read with ease, pleasure and profit. Only recently, a visitor to my house, who had picked up from my table a number of the *Proceedings of the Geologists' Association*, remarked to me that he had found the articles entirely beyond him, although he once could master its pages. 'Prawns in Aspic' comes home to most of us. Not a few can understand 'Preserved in Formaldehyde' written upon a museum label. What a mountainous form 'preserved in sima' may be, the Gods may know; no ordinary reader of Nature can put meaning into the phrase and not a few others like it. Other subjects than geology are often made equally impossible for the average reader of your wonderful journal. I would beg you to help us, if not in the way suggested, by choosing reviewers who will write an English that carries an obvious meaning.

One who attempts to read
"Nature" through.

The Live Stock Industry and its Development.[1]

By Dr. J. S. GORDON, C.B.E.

STATE AID TO THE LIVE STOCK INDUSTRY.

UNTIL quite recently, all efforts to improve the live stock of the British Empire were left entirely to private individuals—the breeders of pedigree stock—and this small band of enthusiastic workers have left behind them a notable monument to their skill and unremitting labours in the formation of breeds and in the improvement which they effected in the type and quality of pure bred stock.

It was only at a comparatively recent date that the British Government considered the agricultural industry to be of sufficient importance to justify the State in making some financial provision for its improvement and development.

The first parliamentary grant for the special purpose of live stock improvement was voted in 1885. This grant was given to Ireland to be administered under the auspices of the Royal Dublin Society, which adopted the method of subsidising pedigree sires, and thus Ireland was the pioneer country in the British Empire to undertake live stock improvement with the help of a State grant.

Since 1914, parliamentary grants for the improvement of live stock have been made to the Ministry of Agriculture and Fisheries and to the Board of Agriculture for Scotland, and each of these Departments put into operation schemes somewhat similar to those in Ireland.

The live stock schemes originally devised by the Royal Dublin Society were continued and developed by the Irish Department of Agriculture, which was established in 1900, and on the formation in 1922 of separate parliaments for Northern Ireland and for the Irish Free State, still further extensions of the schemes were made by the Agricultural Departments of these two Governments.

The latest published figures for each part of the United Kingdom and for the Irish Free State show the total number of breeding stock, the total number of bulls, and the number of these sires subsidised to be as follows:

	No. of Breeding Stock (Cows and in-calf Heifers).	Bulls.	Subsidised Bulls.
England and Wales	2,790,703	88,405	1287
Scotland . . .	460,317	17,578	937
Irish Free State .	1,332,591	23,275	2205
Northern Ireland .	270,283	4,662	623

From the following table it will be seen that the proportion of subsidised to non-subsidised bulls and the number of breeding stock per subsidised bull vary very considerably in the several parts of the British Isles.

Turning for a moment to the Dominions—

In Canada the improvement of live stock is developed chiefly by two methods:

1. The Live Stock Branch of the Department of Agriculture of the Dominion Government purchase and loans out pure bred bulls to specially organise associations in newly settled districts and in back ward sections in the older Provinces. This syster was commenced in 1913, and 4692 bulls had bee placed out on loan up to 1926, an average of 36 bulls per annum. By this means the value o

	Subsidised.		Non-subsidised.	No. of Cows per Subsidised Bull.
England and Wales	1	to	69	2168
Scotland . . .	1	to	19	491
Irish Free State .	1	to	11	604
Northern Ireland .	1	to	7	434

pedigree sires has been demonstrated and farmer have been induced to purchase pure bred sires fo their own use.

2. By grading beef cattle, sheep, and lamb according to age, quality, and weight when they ar put on the market, and by demonstrations ar propaganda, attention is directed to superior be and mutton. In this way a growing demand fro the consumer for more tender and juicy joints ha been created. This plan has directly assist breeders to improve their stock, as considerabl higher prices can now be obtained for prime mutton, or lamb than for coarse joints. Canadian Government is paying special attentio to this side of marketing with remarkably succe results. The home consumption of meat and per head has gone up considerably since this syste of grading was commenced. Thus, in 1916 consumption of eggs per head was sixteen doz in 1927 it had increased to twenty-eight dozen all exports had ceased.

Australia (Queensland) in 1925 adopted a sche by means of which the Department of Agricultu made available to the approved purchaser of pedigree bull a subsidy of 50 per cent of the co price, provided the subsidy did not exceed £50.

In South Africa a scheme for the distribution o pedigree bulls to farmers in the Transvaal throug breed societies came into operation in 1924. Thes animals are sold to selected applicants at reduce prices. Several of the agricultural schools through out this Dominion have stud farms, and young sire raised on these farms are sold and placed out unde the Department's bull distribution scheme.

Although the value of the State-aided live stoc breeding schemes in Ireland was clearly shown i the great improvement in the stock of the count both in quality and in the increased prices obtain the results achieved were not anything like wh they would have been if the widespread use animals totally unsuitable for breeding purpo had been prohibited. The scrub bull not only i flicted serious damage on the owners of cows, b also lowered the reputation and value of Irish stock and to a large extent neutralised the g effect of the live stock schemes.

[1] From the presidential address to Section M (Agriculture), delivered at the British Association at Glasgow on Sept. 6.

These were the chief reasons which induced the Governments of Northern Ireland in 1922 and of the Irish Free State in 1925 to introduce legislation providing that bulls below a certain standard of merit should not be used for breeding purposes and that all suitable bulls should be licensed. By subsidising pedigree sires we have the means of improving and grading up our stock, and by permitting the use of none but licensed sires we get rid of the inferior animals and prevent them from doing harm. This ensures that the improvement is continuous and that much quicker results are produced.

In England and Wales there is only one premium bull to every sixty-nine non-premium bulls, and there are 2168 cows to each premium sire, whereas in Northern Ireland, where more than half the number of bulls are pedigree animals, there is one premium bull to every seven non-premium bulls and 434 cows to each premium sire. Yet after forty years' experience of the premium scheme, we have found it absolutely necessary to bring in a licensing system to supplement the former owing to the progress of improvement being so comparatively slow.

Great Britain has the reputation of having the best pedigree stock in the world, and yet probably nowhere else in the British Empire is improvement in the cross-bred cattle more urgently needed. It is a strange anomaly that our pure-bred stock are exported to all parts of the Empire and to foreign countries for the improvement of the native stock, while at home our own cross-bred stock are in comparison so inferior to the pure-bred stock.

In Canada, United States, Australia, and South Africa the elimination of the scrub bull has received attention, and these countries in recent years have instituted with considerable success campaigns against the use of inferior sires. Western Australia introduced legislation, which came into operation in 1924, to enable its agricultural department to get rid of scrub bulls.

Is Further State Aid Required?

Would it be advisable for the State to devote larger funds than are granted at present to the improvement of live stock? My opinion is that, as the money which has already been applied to this purpose has proved so reproductive, and as the live stock breeding industry is so important to the whole community, it is questionable if funds expended in any other way could produce anything like the same returns.

In January 1923, Mr. T. P. Gill, who for more than twenty years was Permanent Secretary of the Department of Agriculture, Dublin, stated before the Commission on Agriculture appointed by the Irish Free State, that—

"By the infusion of pure bred blood and better methods of keeping, feeding, and management, producing an animal which matures more quickly, fattens more cheaply, and yields more beef and milk, the intrinsic value, independent of price fluctuations of Irish cattle, has been increased since the Department started in 1900 by about £5 per head. This is based on the estimates of the British Salesmasters who handle this import as well as of the most experienced Irish cattle traders. On the number of cattle exported last year, counting the exports only, this would mean an increased annual income of approximately £5,000,000 for an expenditure of £20,000, or a return of 250-fold."

If we calculate that the increased value was only £3 per head, it means £3,000,000 per annum, or a return of 150-fold.

Some will think, perhaps, that I have laid too much stress on the importance of the pedigree sire in the improvement of stock, but the improvement which has taken place in the stock of the Argentine Republic gives us food for thought. In 1848 the first shorthorn bull was imported into that country. At that time only native breeds existed, animals which from our standard were of very inferior quality and extremely slow-growing. The Rural Society founded in 1875 was the chief agency in bringing about improvement in the live stock of the Argentine chiefly through the importation of pedigree sires and through the shows of live stock held by the Society.

In 1895 native cattle constituted 50 per cent of the total in the province of Buenos Aires. In 1914 this had declined to 3·5 per cent. The cross-breds and half-breds increased during this period of twenty years from 49·2 per cent to 93·9 per cent, and the pure-bred or pedigree cattle from 0·6 per cent to 2·5 per cent.

Similar progress in the case of sheep has been recorded. In 1895 native breeds constituted 16·5 per cent of the total; in 1914 they had fallen to 2·3 per cent. The cross-breds increased during this period from 83 per cent to 95·6 per cent, and the pure-breds from 0·5 per cent to 2·1 per cent. In the other provinces an equally noticeable improvement has been effected.

Between 1895 and 1922, 41,519 pedigree bulls were exported from the British Isles to the Argentine.

To-day the best quality Argentine chilled beef ranks next to the best home-produced, and in Smithfield Market it commands prices higher than some of our own home-produced and considerably higher prices than any other imported beef.

The following figures from the *Statist* show the prices of home and Argentine beef for the year before the War, for 1926 and for 1927:

Class of Beef.	Prices per Stone of 8 lb.		
	Jan. 30, 1914.	Dec. 2, 1926.	Dec. 8, 1927.
Argentine chilled hind-quarters	3s. 8d. to 3s. 10d.	3s. 10d. to 4s. 4d.	4s. 8d. to 5s.
Scottish sides	4s. 6d. to 5s.	6s. 6d. to 7s. 4d.	6s. 4d. to 7s.
English sides	4s. 2d. to 5s. 1d.	4s. 8d. to 5s. 6d.	4s. to 4s. 10d.

English sides, it will be observed, have actually fallen in price since 1914, whilst Argentine chilled beef has risen. The substantial difference in favour of English beef over Argentine chilled beef which existed in 1914 has disappeared. The two principal

factors in this revolutionary change are the use of pedigree sires and marketing methods. Surely no stronger argument could be put forward for the urgent necessity for the improvement of the cross-bred cattle of the British Isles.

NEED FOR EXTENDED RESEARCH.

Although I consider that the pedigree sire is the best foundation for the improvement of live stock, it is by no means the only way by which improvement can be brought about. The changes and improvements already mentioned are largely the results of the ability and judgment of the breeder himself, but latterly he has been assisted considerably by the agricultural scientist, chiefly along four distinct lines of research and experiment: (1) animal nutrition, (2) animal diseases, (3) animal breeding, (4) marketing.

Animal Nutrition.—Animal nutrition is of the greatest importance from three points of view—

(*a*) Most stock owners will agree that the greatest mortality in live stock is due either directly or indirectly to imperfect nutrition and not to disease—probably seven out of every ten deaths occurring on farms in the British Isles (excluding those caused by accidents) are due to imperfect nutrition.

(*b*) Owing to early maturity and forcing young animals forward to an age when they are ready to be killed, a much more thorough knowledge of foods and the science of feeding is necessary than under the old system. In the case of cows with high milk yields and of poultry where high egg records are being produced, such knowledge is specially required.

(*c*) The practical farmer as a rule has little or no knowledge of how to form well-balanced rations; indeed he has a very slight knowledge of the composition of foods and of their physiological action. How could it be otherwise when we consider that it is only of recent date that attention has been given by agricultural scientists to the necessity for balanced rations in feeding different kinds of stock and how little even they know about the digestibility of foods, the proper balance of a ration, and the action of minerals in relation to health and disease resistance.

In 1890 the British Government gave local authorities (county councils) in Great Britain grants to be used either for reducing rates or for agricultural and technical instruction purposes. Many of the county councils from the beginning utilised those funds entirely in developing agricultural and technical instruction schemes, and in later years all the county councils expended these grants in this way. From 1890 until a few years ago practically all the funds made available to local authorities for the development of agriculture were applied to agricultural education, experimental and research work chiefly in connexion with soils, manures, and crops, comparatively small amounts being devoted to research and experimental work on live stock problems.

While I realise the great advantage to be gained by the application of science to soil, fertiliser, and crop problems, the chief factor in the British Isles is live stock, and it has been to a great extent neglected. It is the chief source of our farmers income—the hub of the wheel—and, so long as the production of live stock is an economic success and crops are utilised chiefly by converting them into live stock products, more attention should be given to research on live stock problems than to the experimental side of soils, manures, and crops.

This position is, however, being rectified, and w have now research stations engaged in animal nutrition work at Aberdeen, Cambridge, Belfast, and Dublin, but the funds available are quite inadequate if this work is to be developed on broad lines and is to be of practical assistance to the stock breeder in his efforts to overcome many of his difficulties and losses.

Animal Diseases.—I am sure that no one w question the need for extended research into t diseases of our farm animals or the necessity protecting our live stock industry against epidem which annually threaten it so seriously. In co nexion with the latter I may refer to the outbrea of foot-and-mouth disease in Great Britain, whi have been almost continuous since 1919, and ha been the cause of the loss of so many stock throu slaughter. During the last nine years, 1919–19 no fewer than 162,214 cattle, 114,679 sheep, 71,5 pigs, and 256 goats have been slaughtered, and t compensation paid to farmers amounted £5,314,000. This does not by any means co the full value of pedigree stock, as only commer prices are paid in compensation, nor does it inclu the administrative expenses incurred in stamp out each outbreak of this disease. Moreover, wh whole herds of pedigree stock are slaughtered means in many instances the destruction of life work of breeders—work which can neve replaced—and for this loss no sum could compensate the breeders or the State.

Here is a field of research which would jus the State in devoting large sums in order to emp the most skilled scientists obtainable to ascertain a means of prevention. When we consider th enormous cost to the nation and the constant danger of losing our best pedigree herds, as well as the possibility of losing our trade in pedigree stock with other countries, the justification for further and immediate research in this direction is apparent.

Considerable loss to our agriculturists is caused by many other animal diseases regarding the prevention of which very little is known. The most important are tuberculosis, abortion, infertility or sterility. The first named not only causes loss through the death of animals but also is a constant source of danger to human beings through the consumption of milk from tubercular cows. The latter two diseases are widespread in many areas and affect seriously the production of stock. These are only a few of the many animal diseases into which research is required and for which adequate funds are urgently needed.

Animal Breeding.—One of the greatest problems

which breeders have to face in the management of their studs, herds, and flocks, is the selection of sires. Both amateur breeders and old experienced breeders have the same difficulty, namely, how to select a prepotent sire. The only way in which breeders can determine this at present is by the offspring. This means a delay of two years in the case of beef cattle and from three to four years in the case of dairy cattle. If, at the end of that time, the sire proves unsuitable, the owner may have from two to four crops of calves inferior to their parents and, therefore, of no use in improving the herd, and such animals have to be sold at an unremunerative price. The owner suffers a considerable loss in time as well as money, and runs the risk of ruining his herd if he retains animals of this blood.

Owners of small flocks or herds cannot afford to keep more than one high-priced sire, and therefore are handicapped much more than those who own large herds or flocks. The latter can afford to keep a number of sires on trial, mating each with only a few females until each sire is proved, instead of risking all the herd with one unproved sire, as has to be done in most cases by small breeders. In Scotland most of the herds of pedigree cattle are in the possession of tenant farmers, many of whom have only small farms. In Northern Ireland there are 682 pedigree herds, and the majority of the owners have farms less than fifty acres. These breeders could not afford to keep more than one sire or to pay a very high price for a pedigree sire. Money may enable the breeder to procure a high-class sire of a fashionable pedigree, but this is no guarantee that the sire will prove to be a good stud animal. Experience and judgment also assist the breeder in his selection, but even the most experienced breeders and keenest judges often purchase animals which turn out quite unsuitable as sires.

Another problem is how to induce breeders of commercial stock and even breeders of pure-bred dairy stock to keep bulls until such time as the value of their progeny can be determined, and then to retain, so long as they will produce stock, those sires which are proved to be suitable. This question is of the greatest importance in dairy herds, where frequently the bull is dead when his daughters are proved to be good yielders of milk and butter-fat. Well-bred bulls should be retained until the daughters have demonstrated their sire's true value, and, by the exclusive use of such pure-bred bulls, a real advance would be made in the breeding of dairy stock.

Many pedigree herds and flocks have made names or high reputations simply as the result of having one prepotent sire, and when that sire died these herds for years afterwards lost their reputation for high-class stock. If the animal geneticists could show how to diagnose a prepotent sire or how to breed animals with this hereditary trait and make breeding more of a certainty and less of a gamble, it would encourage and give a stimulus to the breeding of high-class animals, which would reach much further than any form of State subsidy given directly to breeders of pedigree stock, and would be worth millions in money to stock breeders throughout the world.

CONCLUSION.

To sum up, I should like to emphasise the supreme importance of the live stock side of our agricultural industry, the immense scope for development which exists, and the exceedingly rapid strides which can be made in its development by the application of our present knowledge along properly organised lines. We can do for stock in the relatively short period of ten to fifteen years what has been accomplished for crops from 1840 to the present time. Unless we bestir ourselves and organise our efforts we shall find our home markets for stock and stock products in the hands of our competitors, who already, by purchasing the best of our pedigree sires, are placing on our markets products which are superior to the great bulk of our home-produced supplies.

The pressing necessity at the moment is for improvement in our commercial cattle—the great disparity between them and our pedigree stock is little short of tragic. The means towards this end are: (1) The increased use of pedigree sires, and in this direction the State can with great advantage to itself provide a powerful stimulus by the rapid extension of the premium scheme; (2) the elimination of the scrub bull, which, to my mind, with human nature as it is, will only be accomplished in an effective manner by legislative means.

It must not be forgotten, however, that as progress is made in grading up our stock by breeding methods, it is imperative that there should be corresponding developments in our knowledge of nutrition, disease resistance and elimination, and in animal genetics. Research in these branches of agricultural science has in the past been starved. The funds devoted to such work are quite inadequate when viewed in the light of the importance of the live stock industry, which in England and Wales alone is worth, approximately, £154,000,000 per annum.

In connexion with this work may I stress the necessity for such research to apply itself more directly than at present is the case to the solution of practical problems. I realise clearly the need for fundamental research, or, as it is now called, long-range research, but agricultural scientists should be, as the designation implies, essentially applied workers. In setting themselves some of the problems which I have sketched, they will meet with sufficient really fundamental problems to keep them employed for many years to come.

Finally, I would reiterate the necessity for a comprehensive reorganisation of our methods of marketing stock and stock products. If it can be accomplished on a voluntary basis so much the better, but I am convinced that compulsory legislation will eventually be necessary. Much valuable time will be saved by facing this position at once. There is a bright future for the live stock industry, but only if we are prepared to attack the problems which it presents in a live and organised manner.

The Synthesis of Cane Sugar.

THE END OF A CHAPTER.

By Dr. E. F. ARMSTRONG, F.R.S.

THE synthesis of cane sugar in the laboratory has brought to triumphant completion a long chapter of endeavour on the part of the chemist. It has always been regarded as the crowning success to be won in the long series of victories achieved by the chemist in synthesising natural organic products, which began with Wöhler's first synthesis of urea a hundred years ago. It is of considerable interest, therefore, to indicate some of the stages of progress and the lessons which have been learned from them. A technical and, even more, a commercial synthesis of this product of the sugar cane and of the beet remains to be effected, but the possibility of doing this in competition with the plant is very remote.

The origin of the sugar cane is obscure, but it is known that it has been cultivated in eastern tropical Asia from great antiquity and that it spread westwards and eastwards, reaching the new world early in the sixteenth century, and the West Indies in 1641. Markgraf in 1747 was the first to find sugar in the beet, thereby pointing the way to the foundation of the beet sugar industry in Europe, which did not actually commence, however, until 1801.

Naturally, cane sugar early engaged the attention of the chemist, and the first experiments to determine its empirical formula date from Lavoisier, though it was only definitely established by Liebig in 1831. Whilst the question of the constitutional formula of the sugars, and of cane sugar in particular, has persistently occupied the activities of many chemists, the chief progress made will always be associated with the name of the master, Emil Fischer, whose achievement in unravelling the complex stereochemical relationships of the isomeric hexose sugars and in effecting their synthesis stands second to none other in the domain of organic chemistry.

Sucrose was shown to be a compound of the two simple hexose sugars, glucose and fructose, combined together in such a manner that the product was highly susceptible to hydrolysis by the weakest acids, but very stable towards action by alkalis. As the investigation continued it became clear, partly owing to the work of Tollens, that glucose and fructose, when in combination with other substances, existed preferentially, if not entirely, not as aldehyde and ketone respectively, but behaved as if they had the structure of compounds containing a carbon-oxygen ring. For a long time this ring was considered to consist of four carbons and oxygen, though it is true that the assumption was based mainly on the analogy with the acid lactones and was without any definite chemical evidence. The hypothesis gave a ready explanation of the existence of two isomeric series of glucose derivatives and of isomeric glucosides.

The constitutional formula of cane sugar was formulated by Fischer and by Tollens on the basis of a four carbon-oxygen ring structure for its components, and many attempts were made to effect its synthesis by combining them or their derivatives in synthesising natural products. In no case were these efforts—and they were numerous in the years 1890 to 1910—rewarded by success. A claim by Marchlewski in 1891 has never been accepted by sugar chemists, and even the possession of crystalline acetochloro derivatives of the sugars failed to give the much-sought-after cane sugar.

The work of the St. Andrews school, started by Purdie, particularly of Irvine, in studying the methylated derivatives of the carbohydrates opened up a new field of investigation, out of which it was found that glucose reacted in other forms than the accepted stable ring, and afterwards that the supposed ring structure of glucose itself had to be challenged. The work during the next decade, after some disillusions, has evidenced further complexity in this already complicated field. Suffice it to say that it has been proved for each of the sugars that it can react in more than one ring form according to circumstances, whilst the particular ring form present in reference compounds has been studied. In this connexion the work of Haworth deserves the highest possible recognition.

There was thus established an up-to-date formula for sucrose—differing very little, it is true, from that of Fischer and Tollens—which enabled once more hopes to be held out of effecting the so long sought synthesis. Hopes, but no certainty, for, as workers in the field of the sugars know well, the experimental difficulties are extreme, because, whilst the glucose element in sucrose is, in the stable so-called α-modification, easy to make and to purify in the form of its compounds, the fructose element is, in the γ-modification, which is unstable, difficult of isolation, even in its derivatives, and likely to change. The many efforts of a thoroughly systematic and scientific character to effect the synthesis of sucrose from the requisite derivatives of α-glucose and γ-fructose have met with no better success at the hands of Irvine and his school, of Haworth and his co-workers, than attended those of Fischer and Armstrong, Ryan and others, all of whom had the potential components of the elusive sucrose at their disposal. Complex mixtures, apparent isomerides of sucrose itself, always resulted.

More success has now attended the efforts of our Swiss colleagues, Pictet and Vogel, who, working on much the same lines as their predecessors, sought to condense the tetra-acetate of α-glucose with the tetra-acetate of γ-fructose in the presence of phosphoric anhydride. A complex mixture resulted, from which a well-marked crystalline constituent was separated on solution in boiling alcohol and subsequent cooling. This product has proved to be identical with sucrose octacetate in melting-point and optical rotatory power.

On hydrolysis, cautiously effected by means of sodium methylate, sucrose itself was obtained in measurable crystals. Naturally, in a matter of such importance, the identification of the synthetic sugar has to be very complete. Pictet and Vogel's product had the correct optical rotatory power both before and after inversion; the melting-points of the modifications, crystallised from ethyl alcohol and from methyl alcohol, were also the same as those of the natural product: sweetness and other properties were in accordance with expectation. There seems no room for any other course than a whole-hearted acceptance of the synthesis and the congratulation of Pictet and Vogel on their truly great achievement.

Much is to be learned from this chapter of chemical science—not the least being the value and necessity of manipulative skill of the highest order, involving an apprenticeship and a practical training of a rigour which is sometimes in danger of being overlooked to-day. Again, there can be no better example of the need of maintaining an open critical mind towards accepted conclusions and the advantage of reopening a question, in spite of apparent finality, when new view-points arise.

Writers of detective fiction have taught us that the end of a chapter is by no means the least exciting portion, and this is obviously true of the sucrose chapter. If its structure has now been established and confirmed by synthesis, more than ever is it necessary for the organic chemist to look inside the molecule so as to explain, for example, its behaviour on acid hydrolysis and the readiness with which the hexose molecule can assume different forms. The original formula of glucose, as an aldehyde, postulated a very active substance; perhaps we shall learn how and why this may react in many different modifications according to circumstances, thus providing a clue to reactions in the plant and in the animal.

The physicists proceed apace with a knowledge of the structure of the atom; in the domain of contact catalysis, much has been done to gain an explanation of the nature of absorption at the surface of a catalyst, and an understanding is being sought of how a catalyst works,—whether, for example, an impact of energy proceeds from one point in an organic molecule, at which it is received, along a carbon chain to another point at which the actual chemical change occurs.

It may well be that the study of the subtle changes in internal structure in the sugar group, where a unique series of highly specific catalysts is available, will be highly fruitful, and it is with this hope that we confidently await the beginning of the new chapter. The one we close is full of fame—a long list of honoured men of science of all nations, of which but a few have been mentioned, have each in their turn contributed to a problem which has all too long baffled solution. There can be no more appropriate celebration of the centenary of the first organic synthesis.

The Artificial Silk Industry.

AMONG the new industries of the present century, there are few which have developed so rapidly as the artificial silk industry. In a "Survey of Textile Industries"[1] recently issued, much interesting information is given about this now important industry. It is pointed out that scientific research and experiment have played an essential part in its development. Production on a commercial scale dates back to 1896, when a few hundred tons were produced in France by the nitro-cellulose or 'Chardonnet' process, though since then the viscose, acetate, and cuprammonium processes have been perfected. Of these, the viscose is now the most general, and is estimated to account for at least 80 per cent of world production. Each of the methods differs to some extent in regard to the raw materials used, and also in the chemical treatment employed. Their respective products vary from each other in regard to strength, fineness, lustre, permeability to moisture, etc. In all, however, the essential feature of their manufacture consists of a succession of chemical processes applied to cellulose, derived generally from wood or cotton. In the viscose method, for example, sulphite wood pulp, obtained from pine or spruce logs, forms the raw material. The cellulose is first converted into a viscous pulp, which is then squeezed through small nozzles and emerges in the form of continuous filaments, which after further chemical treatment can be converted into yarn by a 'doubling process.' More recently, it has been found possible to produce short lengths known as 'staple-fibre,' which can be spun like cotton or wool.

In the Committee's report it is shown that, from a commercial point of view, artificial silk has certain important advantages over cotton, wool, or natural silk. Its price is not affected by fluctuations in supply due to unfavourable weather or the ravages of insect pests. Its raw material (timber) is abundant, and output can be expanded (with the proviso that steps may have to be taken eventually to safeguard future timber supplies) to almost any extent by the erection of the necessary factories. Its price is mainly dependent on the cost of manufacturing processes, and these are more amenable to human control than are the direct products of Nature. Nor is its production necessarily confined to nations possessing a particular type of climate or other natural resources. The industry has, in fact, been developed mainly in industrial countries which, besides being favourably situated for obtaining raw material, possess a well-developed chemical industry and a supply of trained chemists and other skilled employees.

As is well known, there has been a remarkable expansion of the industry since the War. At first, the new fibre suffered from certain defects, such as inflammability and liability to damage by

[1] Committee on [illegible] and Trade. Survey of Textile Industries—Cotton, Woo[illegible] being Part 3 of a Survey of Industries. Pp. vi + 328. [illegible] Stationery Office, 1928.) 3s. 6d. net.

moisture, but since the War these defects have been overcome and the product has been made more attractive. Changes in fashion and the increasing demand for elegance in wearing apparel have greatly extended the market. At the same time, the price of natural fibres, such as wool and cotton, had soared to unprecedented heights, while the price of artificial silk was falling substantially and seemed less likely to fluctuate. Economic conditions were thus favourable to a rapid expansion in its production.

Artificial silk differs from other textile fibres in being a continuous smooth filament without scales or protruding hairs. Though not so strong as cotton or so elastic as wool, it has the advantages of softness and peculiar dyeing properties. It can be used alone or in combination with other textile materials for the production of a large variety of manufactured articles. By utilising artificial silk, the older textile industries have been enabled to produce new kinds of fabrics as well as novel designs and original forms of ornamentation.

Though the industry originated in France, leadership had passed to Germany and Great Britain by 1913. In 1922 the United States took the first place in regard to the volume of production, while more recently a notable feature has been the rapid rise of Italy to second place.

In Britain, Germany, the United States, and Italy there has been a marked tendency towards increasing the scale of production, as it has been found that the large firm can introduce important economies of production. A movement towards international syndication has also become noticeable, and this would appear to have been due in the main to a desire to improve marketing facilities. There has been a rapid growth of important and intricate international agreements among producing firms, and in this movement British interests have taken a leading part. In 1927 the three largest firms in Britain, Germany, and Italy entered into agreements with each other, and it is said that this combination controls more than 70 per cent of the world's production of artificial silk.

Obituary.

SIR HORACE DARWIN, K.B.E., F.R.S.

SIR HORACE DARWIN, whose death on Sept. 22 is widely regretted, was born in 1851, the fifth son of Charles Darwin and the third of the group of brothers to become a fellow of the Royal Society. He was educated at Trinity College, Cambridge, taking his degree as a Senior Optime in 1874. Immediately afterwards he entered the works of Messrs. Easton and Anderson and went through the ordinary apprenticeship course in the shops. While there he designed and built his first instrument, a klinostat, for demonstrating responses of a plant to the stimulus of gravitation. At the end of his apprenticeship he returned to Cambridge, and shortly afterwards joined Dew Smith, who was engaged in designing and making instruments for physiological investigations.

Michael Foster had recently come to Cambridge, at first as Trinity prælector in physiology, later as professor, and found that for nearly all the apparatus he required, only German instruments were available. Darwin and Dew Smith became partners and started the organisation which at a later date grew into the Cambridge Scientific Instrument Company. During this period, along with his brother George, he designed a bifilar seismograph which was set up in a basement room at the Cavendish Laboratory. The rocking microtome, developed from an idea of W. H. Caldwell, was one of the instruments designed during the partnership which has proved of very great value to biologists.

At first the apparatus dealt with was mainly that needed in a biological laboratory, but before long the range was extended. Callendar's work on the platinum thermometer (1883–95) directed attention to the electrical method of measuring temperature; the need for resistance boxes designed for thermometry was further emphasised by Griffith's experiments on the mechanical equivalent of heat (1893), and electrical instruments of various kinds were taken in hand. After ten years the partnership came to an end. Dew Smith retired, and in 1895 the Cambridge Scientific Instrument Company was constituted. Darwin was chairman and the chief shareholder.

It was soon recognised that we had at Cambridge a firm of instrument makers the work of which would bear comparison with any in the world, while the head of the firm was a man with a genius for design and a knowledge of mechanics which enabled him to express his design in the simplest form consistent with the purpose for which the instrument was intended. In 1903 the value of his work was recognised by his election as a fellow of the Royal Society.

In 1909, at the suggestion of Lord Haldane, Mr. Asquith appointed the Advisory Committee for Aeronautics "for the superintendence of the investigations at the National Physical Laboratory and for general advice on the scientific problems arising in connexion with the work of the Admiralty and War Office in Aerial Construction and Navigation." Darwin became a member, and threw himself into the work with his usual energy and devotion. It was clear that measurements both on the full scale and in the wind tunnels at the laboratory were needed; for these instruments were required, and the Committee turned to him for suggestions and advice. Methods for measuring the stresses in the structure of an airship and the strength of the fabric interested him; the vagaries of the compass soon attracted the attention of the Committee, and with some of these he dealt in notes submitted to his colleagues. At a later date he watched with keen appreciation the work of Keith Lucas on the compass, and realised the importance of a 'turn indicator,' a device to assist the pilot in maintaining a straight course. His

own instrument for this purpose proved of value in a critical time.

During the War Darwin was an active member of various committees, and in 1917 became chairman of the Air Inventions Committee. His height finder, for determining the height and position of an object in the air, developed as it was by A. V. Hill and his associates, was perhaps the most important of the devices for which he was personally responsible, but his advice and help were sought continually by many workers.

Darwin's own views as to instrument design are expressed in his Wilbur Wright Lecture delivered in 1913, or more fully in the article which he contributed with his colleague, Mr. C. C. Mason, to the "Dictionary of Applied Physics" (vol. 3, Instruments, the Design of Scientific). Maxwell in 1876 and Kelvin on many occasions had laid stress on the importance of geometric design; he quotes with approval Maxwell's statement ("Handbook to Loan Collection of Instruments," 1876): "When an instrument is intended to stand in a definite position on a fixed base, it must have six bearings so arranged that if one of the bearings were removed the direction in which the corresponding point of the instrument would be left free to move by the other bearings must be as nearly as possible normal to the tangent plane at the bearing." He then shows by examples the advantages of adopting a geometric design, though he is careful to point out that there are cases when it is best to disregard the principle entirely. As to the qualifications of the designer: he is to be "a mechanical engineer with much scientific knowledge, well acquainted with the methods of manufacture available, and in order to avoid unnecessary cost the instrument should not require great skill to make."

Those who knew him and his work will agree that Darwin filled the bill far more completely than any of his contemporaries. His father's letter congratulating him on having passed his previous examination, quoted in the *Times*, applies in full measure to him. Discussing what makes man a discoverer of undiscovered things, Charles Darwin wrote: "The art consists in habitually searching for the cause and meaning of everything which occurs. This implies sharp observance and requires as much knowledge as possible of the subject investigated."

It was Darwin's habit to study from all sides the purpose for which he was asked to design an instrument, to acquaint himself by careful observation with the details of the experiment or measurement to be carried out, and then when thoroughly saturated with the problem, to evolve, sometimes with extraordinary rapidity, a piece of apparatus suited for the work. His interest extended to all the instruments made by his Company, though in a varying degree. Among those which find a place in the booklet describing special instruments for which he was more directly responsible, are a cathetometer made twenty-five years since for the National Physical Laboratory—a similar instrument is now being constructed for Japan—a spectroheliograph designed for the Solar Physics Observatory at Kodaikanal, a camera for taking star photographs—the result of a suggestion made by Prof. Turner—and various forms of comparator, specially those built for the Indian Geodetic Survey, in which were embodied a number of suggestions due to Sir David Gill. Some of his aeronautical instruments have already been mentioned. Experiments to determine the value of g always attracted him; the half-second pendulums made at Cambridge are well known, and the last piece of apparatus he was able to design himself was a vacuum box for Sir Gerald Lenox-Conyngham, in which to swing the pendulums for a projected survey. The drawings for this are in pencil on squared paper and are dated August 1925.

The changes which have taken place during the last fifty years in British instruments are far-reaching, and throughout the industry Darwin's influence was felt; he was a leader in the advance, the guide who pointed out the direction in which improvement was to be found, the friend who never grudged the help he was able to give.

This is not the place to write in detail of Darwin's other activities. He was a member of the Cambridge Town Council for some years, Mayor in 1896–97, and in 1919 he was appointed one of the Royal Commission to inquire into the Universities of Oxford and Cambridge. He married in 1880 the Hon. Emma Farrer, and leaves two daughters; his only son was killed in the War. R. T. G.

THE oldest seismologist in Italy, or indeed in the world, Prof. Giulio Grablovitz, died on Sept. 19. He was born at Trieste in 1846. Though without academic training, his fitness for geophysical studies was recognised by his appointment in 1885 as director of the geodynamic observatory of Casamicciola, founded as the result of the disastrous Ischian earthquakes of 1881 and 1883. At this observatory he remained for more than forty years, until its suppression in 1926, furnishing it entirely with instruments of his own design, his horizontal pendulums, and his well-known geodynamic levels. He was also a member of the government commission which planned the geodynamic branch of the central meteorological office, and was one of the founders of the Italian Seismological Society. C. D.

WE regret to announce the following deaths:

Prof. Panagio Cawadias, a distinguished archæologist of Athens, who was an honorary member of the Section of the History of Medicine of the Royal Society of Medicine, on July 21, aged eighty years.

Dr. S. F. Clarke, professor emeritus of natural history at Williams College, known for work on the hydroids of the American coast and on the embryology of the alligator, on Aug. 1, aged seventy-seven years.

Dr. P. E. Goddard, curator in anthropology in the American Museum of Natural History, who was known for his studies on the linguistics of the Apache Indians, on July 12, aged fifty-eight years.

Dr. C. L. Wilbur, Chief Statistician of the Division of Vital Statistics of the U.S. Bureau of Census from 1906 until 1914, on Aug. 9, aged sixty-three years.

News and Views.

The Bishop of Birmingham's paper at the Church Congress on "The Uniformity of Nature and the Freedom of Man" was an utterance of great interest to students of science. Dr. Barnes did not claim to provide any final solution of the problems which surround this subject; but, what is perhaps an equivalent service, he indicated where the real problems lie. He said that we are confronted with two which are "unsolved and at present insoluble." In the first place, we cannot understand how mental processes can affect physical events; and, in the second place, "assuming that mind has an influence in the physical world, we cannot explain why the laws of that world appear to form a closed system." Dr. Barnes did not consider the first difficulty solved by the assumption that "there is associated with mind some 'vital force,'" since it has not yet been possible to point to any definite process in which such vital force discloses its activity. Nor, as a solution of the second difficulty, would he accept the idea that the will may exercise a sort of directive power without interfering with the principle of the conservation of energy, since all such contentions fail to satisfy the mathematical physicist.

Dr. Barnes reminded his hearers that the twentieth century, like the seventeenth, has opened with a remarkable series of scientific discoveries. In the seventeenth century the result of these discoveries was the rise of new philosophic systems, notably that of Descartes, which "in a popular and debased form held its own until the nineteenth century." It is an obvious reflection that whereas in our own century the corresponding new scientific discoveries (notably those in the sphere of physical science) have taken place, we still await the genius who will embody them in a new philosophic system. The nineteenth-century naturalism is for practical purposes a form of Cartesianism, and no longer tenable. Will the new philosophy, when it comes, provide an adequate solution of the body-mind problem? Though he nowhere definitely says so, we conceive this to be the hope of Dr. Barnes. For the present he will not contribute to confusion of thought by adding to the number of expedients whereby many have sought to escape from the existing *impasse*. As he puts it: "I do not pretend to be able to explain the relation of mind and body, and I confess that none of the many theories which have been put forward are free from objection. But it seems to me that the physical and psychical worlds are in truth only different aspects of a single unity." And if these last words do offer a solution, it is one that is perhaps foreshadowed by the new physical theories. As Einstein has made us aware that space and time are artificial constructions by which the human mind breaks up a single unity, so it may be that the body-mind dualism is an artificial construction. Dr. Barnes, with his customary candour, admits that "it is difficult to realise in what way the physical side of the unity can belong to a mechanistic system, complete in itself, while the psychical side is not so limited." Yet is it certain that the physical side is as completely mechanistic as it seems? Prof. Eddington has said, apropos of the new quantum mechanics, that "whatever view we may take of free-will on philosophical grounds, we cannot appeal to physics against it."

We are inclined to wish that Dr. Barnes could have found space to deal with the psycho-physical problem from the side of physiology as well as from the side of physics (though the latter of course is his own proper province). To many it appears that the researches of neurologists like Sir Charles Sherrington and Dr. Henry Head have shed much light on the function of consciousness, and the nature of spontaneity. The thinking public, however, will register another addition to the debt of gratitude which it already owes to a bishop whose candour is as notable as his learning.

In December last, a few hours after one of the Christmas lectures to juveniles had been given at the Royal Institution, there was a series of alarming explosions in an electric main outside the building. Windows of the Institution were broken and the basement was filled with poisonous gas; and it is easy to understand that had the explosions occurred while a lecture was being given deplorable consequences and loss of life might have followed. Though the cause of the accident was outside the Institution, yet the managers were forced by it to give serious attention to conditions of safety and possibilities of escape from the building in case of fire or panic. A report was therefore obtained from the architect, and the result is the definite conclusion that the lecture theatre is not fire-proof, that there are not sufficient direct exits to the street, and that the gallery may almost be a death-trap. The fact that there has been no accident or loss of life in the theatre during the existence of the Institution does not absolve the managers from responsibility for the future now that they have the possibilities of danger so clearly shown by the architect. It was on this account that a special meeting of members was summoned for Monday last, for the particular purpose of empowering the managers to prepare plans for any essential alterations to the structure in order to bring it within modern building regulations as to safety without destroying the historic character of any part of the Institution. The meeting approved of the managers' action and empowered them to proceed with the preparation of the necessary plans for submission to a further meeting of members in November.

It is estimated that a sum of something like £75,000 would be required to remove all objections that can be raised against the safety of the lecture theatre while preserving its present character, to provide easy and sufficient exits, to construct certain new rooms and corridors, and generally to enable the building to satisfy existing regulations for public buildings in which audiences assemble or work is carried on. Should the members of the Institution decide, as eventually they must have to do, that the theatre and certain other parts of the building should

be reconstructed, there ought not to be much difficulty in securing the amount required for the purpose. The Royal Institution has a world-wide reputation, not only for brilliant research, but also for its work for the extension of interest in progressive knowledge by means of the Friday evening discourses and other stimulating lectures. In its laboratories the great electrical industries were created by Davy and Faraday, and it is scarcely too much to say that most British leaders of science in the past century or so have been associated with the Institution in one way or another. If it is reported, therefore, that for safety's sake alone a large part of the Institution must be reconstructed, then it is the duty of the members and the managers to see that this work is put in hand, and it is hoped that they will be relieved at an early date of any anxiety as to the provision of the necessary sum to carry out the work in full sympathy with the wonderful historic past of the Institution and with the desire to ensure its continuance in perfect safety.

AT the northern end of St. Martin's Street, Leicester Square, in neighbourly proximity to the offices of this journal, a building of architectural distinction and pride of frontage has been in course of erection for many months past. Destined as it was to be the habitation of a new public library for the City of Westminster, it offered ample compensation for one formerly in St. Martin's Lane, long since transferred elsewhere in order to meet local exigencies. On Monday last the Dean of Westminster performed the opening ceremony on behalf of the Mayor of Westminster and the chairman and members of the Public Libraries Committee. A large company was present. Special interest attaches to the occasion, for on the site of the new library stood the historic dwelling-house of Sir Isaac Newton, occupied by him from 1710 down to 1725, when ill-health necessitated removal to Kensington, where he died two years later. In course of time, and during the residence of Dr. Charles Burney, the house became known as Newton House, and was the rendezvous of a musical, literary, and artistic coterie, which included Garrick, Sir Joshua Reynolds, and Dr. Johnson. Adjoining on the site, and also demolished, was the Orange Street Congregational Chapel, erected originally in 1685 for Huguenot refugees. An inscription on the façade of the new building gives Newton's period of living at his house as 1710–1727. Presumably the latter date should have been cut 1725, for Brewster tells us that the philosopher left St. Martin's Street early in that year for Kensington, and certainly he did not return. The Dean of Westminster, speaking on books and knowledge, referred to the great gift conferred on the population of that part of the municipality by the provision of the library. The historical associations garlanded around the spot should themselves serve as a mental stimulant.

THE Pereira Medal, awarded annually by the Pharmaceutical Society of Great Britain, was presented on Oct. 3 to Mr. Hubert A. Turner, who was the first candidate in England to pass the new Ph.C. examination held early this year. Jonathan Pereira was a physician who, in 1843, became the first professor of materia medica in the Society's School of Pharmacy. He was a brilliant lecturer and research worker and well known as an authority on his subject. After his death in 1853 a fund was raised by subscription with which a prize was established in the form of a medal called the Pereira Medal. This was to be awarded annually by the Council of the Pharmaceutical Society to the candidate who should succeed at a competitive examination in the subject of materia medica. All candidates must have qualified as pharmaceutical chemists since the last examination for the Medal took place. The Medal has been awarded each year since 1861, and is regarded as the 'blue ribbon' of pharmacy.

AT the opening of the new session at the Pharmaceutical Society of Great Britain on Oct. 3, Mr. R. R. Bennett delivered the inaugural address, taking as his subject "Pharmacy as a Career." He pointed out that education is not simply the acquirement of items of knowledge but the training and development of the student's faculties: study should be systematic and regular, when a subject can be mastered in what may seem an incredibly short time. It is of great advantage to make notes or an abstract of what is read, since the mere fact of writing impresses the data on the memory and leads to their arrangement in proper sequence. Reading should be methodical and critical: a little, well digested, is better than too much, which may destroy originality and independent thought. The amount of work should be measured by the degree of concentration applied and not by the actual time spent on it, and all work is much easier and more quickly mastered if the student is interested in his subject. For success in pharmacy, as in other professions, interest in the subject chosen for a career and hard work are the essential foundations; and it is achieved by competence, capability, and individuality. The law imposes a certain minimum efficiency as represented by the qualifying examination; but no pharmacist should be content with this. He should keep abreast of recent pharmaceutical research and literature as well as the trends of modern medicine. At the same time he should keep in touch with his professional brethren in order to maintain broad views. It should be the concern of every student to make himself as efficient as possible, so as to enhance the reputation of his profession, and to refrain from any action which might act deleteriously upon it. If possible the student should undertake some post-graduate research in pharmacognosy, chemistry, or pharmacology, facilities for which are provided in the Society's laboratories, and all students should make the fullest use of the opportunities they can enjoy at the Society's School of Pharmacy.

THE Electrical Association for Women, of which Mrs. Wilfred Ashley is president, is undertaking a useful campaign to bring to the notice of architects, electrical authorities, and builders, the importance of suitably wiring new houses for electric light and power. A preliminary survey of the new houses that are being built shows that building authorities are not making

adequate provision for electric supply, and that the electric 'outlets' installed are often in unsuitable positions. It is not advisable, for example, to have an outlet in the centre of a wall space which would otherwise be possible for furniture. In a leaflet the Association gives the plan of the standard house recommended by the Ministry of Health, and suggests suitable positions for the outlets in the various rooms. A large amount of labour-saving can be effected when an adequate electric service is available. In the living rooms outlets should be provided for a vacuum cleaner as well as for the fire, fan, and kettle. There should also be outlets in the bathroom for water heater, towel rail, and fire. The outlets in the kitchen should be waist-high and sunk in the wall. The Association is doing good work by pointing out some of the methods of lessening the drudgery of household work.

IN *Electrical Communication* for July, Mr. Rollo Appleyard gives an interesting sketch of the life and work of Georg Simon Ohm. Beyond the fact that he was the discoverer of Ohm's law, it is safe to say that he is practically unknown. He belonged to a German burgher family well known as locksmiths. In 1805, at the age of sixteen years, he entered the University of Erlangen. Lack of means caused his university career to be interrupted, but he graduated in philosophy in 1811. In 1813, Erlangen was the storm centre of the struggle against Napoleon, no less than 33,000 troops being billeted on the 8000 inhabitants. In 1817, through the influence of King Friedrich Wilhelm III., he was appointed a lecturer on mathematics and physics at Cologne. As a teacher he was inspiring and his zeal never flagged, but it was arduous work to get his discoveries recognised in the German universities. At this period Hegel's philosophy was at its zenith of popularity. As Hartmann said, it is more attractive to prove the laws of Nature by 'sovereign' speculation than to perform the tedious and irksome tasks of observing and testing experimentally. The triumph of Ohm did not come until 1841, when the Council of the Royal Society of London awarded him the Copley medal for his researches into the laws of electric currents. The results of these researches were published in his book, "Die galvanische Kette," and in *Poggendorffs Annalen*. The Royal Society stated that Ohm had established for the first time the laws of the electric circuit. Physicists in England found Ohm's law of the greatest value in their experimental work. Had the law been known earlier the industry of experimenters would probably have led to rapid developments in electrical applications. In 1833 Ohm obtained a professorship at the Polytechnic School at Nuremberg, and in 1849 he was appointed professor of physics at Munich. He died in 1854. Outside the College gates he was little known, but the good seed he sowed has grown and flourished luxuriantly.

THE Leicester Literary and Philosophical Society performs a good work in arranging a winter series of discourses by eminent lecturers, "to enable members to keep in touch with modern thought and discovery in as many spheres as possible, and to afford them an opportunity of forming a personal impression of famous men." The *Transactions* of the Society for 1927–28 contain short contributions on "Chinese Life and Thought," on the petrology of the Swanimote Rock, and on the flora of Rutland. The more intimate work of the Society is carried on by a severe splitting up of its activities into ten sections, each dealing with a particular branch of knowledge, after the manner of the British Association. While subdivision of this kind is necessary on account of the enormous membership of the latter body, it seems doubtful if much is to be gained by so great specialisation in a local society. In view of the tendency of scientific workers to pursue self-contained specialties, there is much to be said for retaining in local societies the broad policy of common meetings, where each interest gathers information from every other interest and keeps in touch with activities all along the front of scientific progress.

THE wide scope of the exploration work undertaken or assisted by the National Geographic Society of Washington was indicated in a paper which Col. E. Lester Jones read to the recent International Geographical Congress at Cambridge. The Society is best known for its *National Geographic Magazine*, a monthly publication which specialises in superb photographic illustrations that are generally of geographical interest. In addition, there are given every month a number of excellently produced colour plates which add much to its value. This magazine has an extraordinarily wide circulation, and has been of great value in schools and in popular education generally. The Society has no endowments or government subsidy, but from the income derived from its journal has been able to devote large sums to geographical exploration as well as to award from time to time the Hubbard gold medal. Among recent efforts of the Society have been help given to the late Admiral R. E. Peary, to Com. R. E. Byrd, including a sum towards his present Antarctic expedition, to many expeditions to Alaska and to the West Indies, especially in regard to the study of volcanology and seismology. Some of these researches have been published in special volumes. It is a matter for congratulation that the profits derived from the sale of a popular magazine, in itself of educational value, are put to such useful purposes.

A BUST of Michael Faraday will be unveiled at the Central Public Library, Walworth Road, S.E., by Lieut.-Colonel Kenelm Edgcumbe, president of the Institution of Electrical Engineers, on Wednesday, Oct. 17, at 4 P.M.

AT the invitation of the Egyptian Government, Sir Jagadis Bose paid an official visit to Egypt on Sept. 12–19. He lectured and gave demonstrations of his recent investigations, which are regarded as having an important bearing on the sciences of agriculture and medicine. The Egyptian Government proposes to send some of the post-graduate students

of the University to the Bose Institute, Calcutta, for special training.

MR. LESLIE HOUNSFIELD delivered his presidential address on "The Integrity of the Technical Man" before the Institution of Automobile Engineers on Oct. 2. The Graduates Prize of the Institution for the session 1927-28 has been awarded jointly to Mr. F. Gaye of the Derby Branch, for his paper on "Notes on Automobile Gears," and to Mr. C. I. Kelly of the London Branch, for his paper on "Petrol Engine Lubricants and Lubrication."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A superintendent of the Zoological Gardens, Clifton, Bristol—Appointments Committee, Zoological Gardens, Clifton, Bristol (Oct. 14). An inspector of materials in the Aeronautical Inspection Directorate of the Air Ministry—The Secretary, Air Ministry (S.1), Adastral House, Kingsway, W.C.2 (Oct. 22). A physician for mental diseases and lecturer on psychological medicine at St. Thomas's Hospital—The Secretary, St. Thomas's Hospital, London, S.E.1 (Oct. 25). A resident assistant pathologist in the pathological department of the Royal Free Hospital and London (R.F.H.) School of Medicine for Women—The Secretary, Royal Free Hospital, London, W.C.1, or the Warden and Secretary, London (R.F.H.) School of Medicine for Women, London, W.C.1 (Oct. 26). A senior lecturer in physics in the Durham Division of the University of Durham—The Head of the Department of Science, University of Durham, South Road, Durham (Oct. 27). A junior lecturer in electrical engineering in the University of the Witwatersrand, Johannesburg—The Secretary to the High Commissioner for South Africa, Trafalgar Square, W.C.2 (Nov. 1). A principal of the University College of South Wales and Monmouthshire—The Registrar, University College of South Wales and Monmouthshire, Cardiff (Jan. 1). A woman lecturer in geography at St. Peter's Training College, Peterborough—The Principal, St. Peter's Training College, Peterborough. A physicist with electrical experience, under the directorate of Radiological Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant lecturer in mathematics, and demonstrator in physics or mechanics, at Faraday House Electrical Engineering College.—Dr. A. Russell, Faraday House, Southampton Row, W.C.1.

Our Astronomical Column.

SEPTEMBER FIREBALLS.—As is usual at this period the year, fireballs have been abundant. On Sept. t. 8^h 45^m, G.M.T., a large meteor appeared in the rth-west sky as seen from Kinsale, on the south coast Ireland. It emitted a bluish-white light and lit up e sky as it fell rapidly from the direction of Perseus.

On Sept. 15, at about midnight, a splendid fireball as observed from Co. Cork. It moved slowly from rth-west to south-west, and displayed gorgeous lours. It was directed from a radiant on the north-est horizon at $239° + 20°$ and pursued a long flight.

On Sept. 21, 11^h 10^m, G.M.T., a fireball brighter an Venus fell from $39\frac{1}{2}° + 25°$ to $42° + 6°$ in 4 seconds seen from Shore Ends, Essex.

On Sept. 30, 7^h 40^m, a magnificent meteor was ewed from many places in the north of England. It aversed a long path, south-west to north-east, from or the River Solway to far out into the North Sea, d was directed from a radiant at $251° - 20°$ or $37° - 2°$ in Scorpio or Serpens. The height of the early horizontal flight was about 57 miles.

EINSTEIN AND RELATIVITY.—R. D. Carmichael ntributes a paper to *Scientia* for September, in which e dwells on the æsthetic side of Einstein's theory of lativity. He points out that this theory was in e main deduced from the central idea of expressing e laws of Nature in such a form with respect to the ur-dimensional continuum that there should be no hange in the form on passing from one system of eference to another. To do this was an effort of pure hought, and the form of the laws resulting from this ffort of thought led to the postulation of the three ell-known astronomical tests of the new theory, amely, shift of perihelion, bending of light by gravi-ation, and shift of spectral lines in a gravitational eld. The conclusion is drawn that "there is a deeply-ounded solidarity between the laws of human thought nd the laws of external nature."

A 'dialogue' on the same subject has been published by A. M. Robertson of San Francisco. It charges Einstein with faking his result for the deflection of light at the sun's limb, 1·75″, from an article published by Soldner about a century earlier. Soldner adopted the corpuscular theory of light and the Newtonian law of gravitation. Through some slips he got a result twice the size that this law really gives, and agreeing with Einstein's shift. But the calculation is such a simple one, and has been verified so often, that there is no question of Soldner being in error; the charge against Einstein is therefore invalid.

MINOR PLANETS.—The present year promises to be a record one for the discovery of minor planets. The number in the first two-thirds of the year is well over a hundred.

The planet 1071, now named Brita, gives a good illustration of the amount of labour that is involved in searching thousands of observations before it can be decided whether an object is really new. 1071 was discovered in 1924, but was not numbered then, the observations being insufficient: last December Herr Reinmuth, in searching for 553 Kundry, found another planet, which was provisionally lettered 1927 *YB*. Mr. B. Asplind calculated a circular orbit for *YB*, which made him suspect its identity with planet 1071. Further research supported the identity. He afterwards found that the object had been detected in 1910, when it was given the letters *JZ*, and some years later it was also detected at Simeis, Crimea, and designated Simeis 99. Mr. Asplind also calculated its place in 1914, and Reinmuth, on re-examining plates of that year, has found images agreeing with the calculations, so that the planet's orbit is now well determined (*Astr. Nach.*, 5584).

Tokyo Astron. Bull. for July 30 last states that the remarkable orbit announced last year for planet 1927 *BD* is erroneous. That orbit was of a cometary character, and extended to the orbit of Uranus. A mistake has been found in one of the observations used. The true orbit is nearly circular, with a period of 6 years 2 months, and an inclination of $17\frac{1}{4}°$.

Research Items.

NATIVE CULTURE OF THE SOUTH-WEST.—Under this title, Mr. A. L. Kroeber has written a valuable analysis of the problems of the anthropology of the south-western United States which consequentially analyses the methods of American archæology and ethnology and more particularly the method of 'cultural areas.' It has been published by the University of California as No. 9 of Vol. 23 of the *Publications in American Archæology and Ethnology*. More especially, of course, the author is concerned with the origins of south-western culture and the direction from which cultural influences penetrated the area. The question is made difficult by lack of information relating to adjacent areas, especially northern and southern Mexico. Incidentally, reference is made to the possibilities of chronological correlation from Mr. Douglass's work on tree-growth which has carried a year identification system for the American south-west back to A.D. 1300, beyond which there is a floating block of several centuries of identifiable year growths. To this block belong rafters from Pueblo ruins, such as Aztec and Bonito, of the third or great Pueblo period, while the Spanish conquest falls into the fourth period. It should therefore be possible to obtain a record back to A.D. 1000, from which period rafters could be obtained to reflect on Mexican conditions of the general Toltec period, and possibly confirm legendary Aztec chronologies. In regard to extra-continental influences in the south-west, little reached the area from South America, though it shares certain elements, such as maize culture, the turkey and rain rituals of South American origin with the central area. Asiatic traits are practically absent, except a hesitating occurrence at the farthest extent of distribution of the sinew-backed bow. Trans-Pacific influences are scarcely to be expected, but in Southern California is the cosmogony of Luiseño and Gabrielino, thoroughly Polynesian in character, and the Gabrielino and Chumash shell fish-hooks, which are strictly Micronesian in form.

POPULATION IN NYASALAND.—Dr. F. Dixey, Government Geologist of Nyasaland, has published in the *Geographical Review*, vol. 18, No. 2, a study of the distribution of population in Nyasaland. According to African standards the population is large, numbering in the 1926 census 1,290,885, a figure which gives an average of 34·6 per square mile as compared with Tanganyika 11·26, Northern Rhodesia 3·2, Southern Rhodesia 5·1, and Portuguese East Africa 7·0. Distribution, however, is uneven, and varies from 201 per square mile down to less than 10 per square mile in an area comprising 21,255 square miles. The most densely populated areas are in the Lower Shiré valley, about Port Herald and the Chiradzu district and adjacent parts of Blantyre. The most sparsely populated area is the northern Nyasaland Plateau, a section which suffers great losses by migration to Rhodesia and South Africa. The population problem is closely bound up with the question of water supply. A number of areas are otherwise suitable for settlement provided water could be supplied. It is especially needed, not so much for agricultural purposes as for domestic use. This is indicated by the alignment of habitations along network of streams in country uniformly equal in soil. For the moment the problem is in danger of being overlooked, owing to the unusually favourable conditions of the last three years. The population tends to concentrate along the lake shore and along the larger streams and rivers. The average number of inhabitants in a village ranges from a minimum of 57 in Blantyre to a maximum of 259 in South Nyasa. There are 18 villages with a population of more than 1000. Kota Kota township is formed of a number of villages with an aggregate population of 5438; but the largest individual village, near Fort Johnston, numbers 2562. In the fertile areas lying in strips along the river valley or lake shore, it is not easy to find an unoccupied site.

THE AMERICAN INDIAN AS A WILD FOWLER.—G. D. Sprot, a Scottish naturalist now resident in British Columbia, contributes an interesting article on the wild-fowling methods of the Indians of Vancouver Island to the *Canadian Field-Naturalist* for September last. His attention was directed to the subject by the discovery of two 70-foot poles, which had been known to stand on the shore since 1862, and must have been the standards of flight nets in use almost a hundred years ago, though no authentic account exists of the use of such nets on Vancouver Island. Inquiry showed that other varieties of netting were employed. On dark still nights dip nets were used from canoes, a torch being lighted and at once extinguished in the neighbourhood of flocks of geese. This performance repeated several times bewildered the birds, so that they did not attempt to fly away and could be quickly scooped out of the water by the net. Drop nets were also employed from canoes, as well as various kinds of arrows and spears, but the most unusual method of capture was the use by young Indians of a natural 'bird lime.' A large wood slug (*Limax*) having been located, was gently stroked until it had exuded a quantity of slime. This was spread in the approved fashion upon prominent twigs on bushes near hovering groups of the rufous humming-bird, and so tenacious was its grip that one coating was sufficient to hold a number of the birds, which the Indian youths treated rather barbarously as playthings.

THE BEAVER IN DENMARK.—The beaver has long been extinct in Denmark, but evidence is accumulating to show that it existed for a long space of time in prehistoric days. A summary of the records has been made by Magnus Degerbol in a recent short paper (*Saertryk. Vidensk. Medd. Dansk. naturk. Foren.*, Bd. 86, 1928). Trees gnawed by beavers found in different peat bogs indicate their presence in the last interglacial period, and similar circumstantial evidence shows that they were one of the early immigrants after the glacial period, occurring during the first succeeding temperature optimum ("Allerødrid"). They were present in the post-glacial forest period, and in the Azilian stone age the occurrence of many bones at human settlements shows that they were hunted by man. Thereafter the traces of beavers begin to become fewer. Bones have been found in the kitchen middens of neolithic age in Northern Sjælland and Lolland, but they are much less numerous than in the earlier deposits, while from the most recent neolithic layers only a single find has been recorded. The author now adds a unique record from a settlement at Hasmark Sønderby which belongs to the Bronze Age, and this is the final record of the presence of the beaver in Denmark.

JAPANESE LAND MOLLUSCA.—The second instalment of Dr. Pilsbry's "Review of Japanese Land Mollusks" (*Proc. Acad. Nat. Sci. Philad.*, vol. 80) deals with that part of the genus *Euhadra*, the only large and conspicuous land shells of the Japanese Empire, grouping about *E. herklotsi*. The group as a whole would appear to have been generally diffused over the Main Island, Shikoku, and Kiushiu with its satellite islands, at some former period of emergence which united them, but without land connexion with

Yesso or Korea. One special pattern of coloration, described as the 'nimbosa pattern,' is restricted to the south-western two-thirds of the Main Island and Shikoku, whilst the sinistral species are confined to the northern half of the Main Island. As yet practically nothing has been recorded of the ecological relations of any of the Euhadras. Systematic descriptions of the species in question are given, and one new species, *E. latispira*, and several new subspecies are defined. The seven plates in illustration are remarkably fine and leave nothing to be desired. There are also figures and sketch maps in the text.

ARTHROPODAN LEGS.—H. E. EWING (*Smithsonian Misc. Coll.*, vol. 80, No. 11, 1928) has investigated the legs and leg-bearing segments of certain groups of Arthropoda. His more important conclusions are as follow: The generalised type of arachnidan leg appears to possess one more segment than the maximum of eight allowed by Hansen for the Crustacea. The generalised pauropod leg is composed of eight rings representing six or possibly seven true segments—coxa, first and second trochanters, femur, tibia, tarsus, and pretarsus—and with this the generalised thysanuran leg is homologous except that it possesses a subcoxa, usually platelike in form. The typical collembolan leg has a subcoxal segment and the tarsus is either lacking or is represented by a short rudiment at the base of the claws. The primitive insectan type of tarsus was three-clawed, as in the Pauropoda, Symphyla, and certain Thysanura; the two- or one-clawed condition found in some Thysanura or in the Collembola is not primitive, but is derived from the three-clawed type. Evidence is discussed bearing on the presence of an additional segment—the cervical—in the insect thorax, which should be considered homologous with the legless postcephalic segment of pauropods and certain symphylids. The primitive thoracic tergal plates were simple structures without condyles or apodemes and did not completely cover the dorsal surface of their respective segments. The primitive thoracic sterna of an insect were probably transversely divided into two sternal plates the posterior of which articulated laterally with the inner condyles of the coxæ.

LEAF SCORCH.—In the *Journal of Pomology and Horticultural Science*, vol. 7, Nos. 1 and 2, July 1928, Mr. T. Wallace completes his examination into this frequent cause of loss to the orchard grower. He concludes that all the available evidence points to leaf scorch arising from defective nutrition, whilst in many cases it develops as the result of unsatisfactory conditions of water supply within the plant. The soil conditions associated with leaf scorch in the field also suggest unsatisfactory conditions of water supply. It has been shown that certain soil conditions are conducive to the trouble; in some of these soil areas proper manurial treatment may enable orchards to be developed profitably, on others the grower would be better advised not to attempt to grow fruit trees. Another paper by Mr. N. H. Grubb in the same journal, upon the effect of potash fertilisers upon apple trees, again shows the value such potash manuring may have, under certain conditions, in preventing the development of leaf scorch.

CAMBRIAN FOSSILS FROM CALIFORNIA.—Twenty years ago Cambrian fossils were discovered in beds resting on an eroded granite surface at Bristol Mountain, near Cadiz, California. There appear to be two layers of fossiliferous shales in the series, of which the upper has been determined as belonging to the Middle Cambrian, but whether the under one should be referred to that or to the Lower Cambrian remains to be decided. Charles E. Resser discusses (*Smithson. Miscell. Coll.*, vol. 81, No. 2) these fossils, which, with the exception of a single Brachiopod (*Paterina*), belong to Trilobita of the genera *Mesonacis* (including three new species), *Pædumias*, and *Dolichometopus*. Three very clear plates illustrate the paper.

UNDERGROUND WATER SUPPLIES OF SOUTH AFRICA.—For nine years Dr. A. du Toit has been associated with the Union of South Africa Irrigation Department, and in the course of his investigations into underground water supplies he has analysed the data and results of more than ten thousand boreholes. The wealth of information so collected has now been conveniently condensed in a paper of the utmost practical and theoretical interest presented to the South African Society of Engineers (*Trans. Mins. of Proceedings*, 1928). Dr. du Toit discusses the mechanism of infiltration; fluctuations of the water-table; selection of sites; yields and resources; and various engineering questions; and finally he summarises the water-bearing qualities of all the chief formations from the Old Granite to the Tertiary beds. The following statement indicates the vast importance of ground waters to the South African communities: "The occupancy of the vast spaces of South Africa and their closer settlement have been made possible principally through the agency of the boring machine. I firmly believe that more has been achieved towards the general development of the country from the comparatively few thousands of pounds spent annually upon State boring than from all the millions expended upon large diversion and storage schemes."

THE TANGO (JAPAN) EARTHQUAKE OF MAR. 7, 1927.—This earthquake, with its toll of 2900 lives, the most destructive in Japan since the great shock of 1923, still engages the attention of Japanese students. According to Messrs. Watanabe and Sato (*Japan Imp. Geol. Surv. Rep.*, No. 100; 1928), its disturbed area contains nearly 60,000 square miles. Up to the end of March, the number of after-shocks recorded was 899. As already mentioned in NATURE (vol. 122, p. 36), this earthquake was due to successive displacements along two pre-existing faults, nearly at right angles. The present authors notice, however, that the faults are not continuous. The more important fault, the transverse Go-mura fault, has a general trend about north-north-west and south-south-west. It consists of a series of eight faults arranged *en échelon*, and, with few exceptions, the rock on the east side is relatively depressed by as much as 1 metre and shifted through 2 or 3 metres to the north. For several miles to the west of this fault the Japan sea coast has been permanently uplifted by amounts ranging up to 1 metre. The authors suppose that the fault is a reversed one dipping to the west, and they suggest that the earthquake was caused by the uplift of the land on the west side, and that the vibrations, when they reached the perpendicular Yotsugi fault, gave rise to a sympathetic earthquake there. Prof. B. Koto, to whom we owe the well-known investigation of the Mino-Owari fault-displacements of 1891, has also made a detailed study of the two faults illustrated by more than fifty photographs (*Tokyo Jour. Fac. Sci.*, vol. 2, pp. 265-329; 1928). He also notices the double origin of the earthquake, and, on this account, he calls it an 'intersecting twin earthquake.'

TANGENTIAL GRATING SPECTROGRAPH.—The firm of Adam Hilger, Ltd., has furnished us with particulars of new products supplied by them, and we notice descriptions of two instruments of particular interest to scientific workers. In the past three years a new

method of studying soft X-rays and the extreme ultra-violet region of the spectrum has been developed by Dr. Jean Thibaud. His spectrograph employs the principle of the tangential grating. When the rays to be analysed are incident almost tangentially upon the grating, the dispersion is increased, the effect being as if the lines of the grating were much nearer together. In this way very pure diffraction spectra of X-rays may be obtained with short exposure. As the rays in question are very easily absorbed, the whole apparatus must be enclosed in a chamber which can be evacuated. The instrument can, however, be set up and taken to pieces in a few minutes, as all the joints are metallic cones or planes made vacuum-tight with rubber grease. By calibrating the grating with a well-known line in the visible spectrum, standard measurement of the wave-length of X-rays is possible. This gives an independent method for determining the dimensions of the space lattice of crystals, which leads to new and precise estimations of Avogadro's number and the fundamental electronic charge.

REFLECTION ECHELON GRATING.—In 1898, Michelson, in describing the echelon spectroscope, suggested the idea of a reflection echelon grating, but realised the difficulty of construction. In a communication to the Optical Convention of 1926, W. E. Williams discussed the theory of the reflecting echelon, and concluded that the progress made in optical technique had made an echelon of this type a practical possibility. Employing his suggestion of a number of fused silica plates of equal metrical thickness placed in optical contact, the firm of Adam Hilger, Ltd., has been successful in making reflection echelons having full theoretical resolving power. Three sizes are available, having 25, 33, and 40 plates, the resolving power (for wave-length 4000 A.) being 875,000, 1,150,000, and 1,400,000 respectively. The echelon is fitted in a levelling mount which provides for visual or photographic use of the grating. The reflection grating presents a number of advantages over the transmission grating, the first and foremost being that it can be used over a far wider spectral range. It may be remarked that some of the advantages of a reflection echelon were considered by Lo Surdo in 1921.

ELECTRICAL THERAPEUTIC APPARATUS.—We have received from Messrs. Watson & Sons (Electro-Medical), Ltd., a brochure on electro-medical apparatus which contains an illustrated account of the standard items of equipment for all branches of physio-therapy. The 'Polytron' valve universal machine calls for special mention. This machine has been designed to meet the demand for a noiseless earth-free unit which will supply the different varieties of current used for therapeutic work, and also power for cautery and light. Alternating current is required. The special features of the machine are that it has no moving parts, it is noiseless and is 'earth-free'; this latter ensures absolute protection to patients from dangerous electric shocks. Considerable space is given to diathermy apparatus, and in some of the more recent designs an open air-cooled tungsten spark gap is fitted in place of the ordinary enclosed gas spark gap.

PHOTOELASTIC DETERMINATION OF STRESSES.—The issue of the *Physikalische Zeitschrift* for Aug. 1 contains an account by Dr. M. Wächtler, of the more recent researches on the determination of the stresses in materials by the photoelastic method. The method has been adopted almost universally where the materials were of such shapes that calculations of the stresses could only be rough approximations. But it has its limitations, and the author is careful to state them. The double refraction produced by stress is not in all cases proportional to the stress, and the deviation from proportionality increases as the breaking point of the material is approached. Celluloid shows both time and fatigue effects from which glass is free. Examples of the method are given in a number of cases in which the stresses are simple and can be calculated, and the agreement between the results of the two methods is found to be satisfactory. References to 102 memoirs on the subject are given.

THE QUANTUM STATES OF ELECTRONS IN MOLECULES.—The first of a new series of papers by Prof. R. S. Mulliken, on the electronic properties of molecules, has been published in the August issue of the *Physical Review*. The ideas and methods he has employed are essentially those of Hund, but these have been supplemented by other hypotheses, the whole reduced to a set of working rules for analysing spectroscopic and other relevant data, and the rules then applied to the diatomic molecules formed by the light elements between lithium and fluorine, the main properties of sixteen such systems being finally collected in a single comprehensive table. It is possible, as Prof. Mulliken himself points out, that some of his results may be very approximate, but he has at least found it possible to correlate a great amount of experimental and theoretical material, and it is probable that conclusions generally similar to those at which he has arrived will ultimately come to be adopted. Prof. Mulliken's opinion on two controversial subjects will be noted with interest; he accepts the view that a molecule C_2 is the emitter of the Swan bands, and he takes the low value of 13·5 volts for the least ionisation potential of molecular oxygen.

TELEVISION AND RADIOVISION.—At the present time, when television and radiovision are developing so rapidly, it is of interest to have a record of the progress that has been made by inventors in various directions. We therefore welcome the pamphlet that has been written on "la télévision électrique" by Dr. A. Dauvillier, who was one of the earliest pioneers in France to propose a system of vision far exceeding the range of the human eye. He divides the systems into two classes. In the first class an attempt is made to transmit all the rays forming the picture simultaneously, and in the second, the rays are sent in succession, advantage being taken of the persistence of images on the retina. The second class is subdivided into others depending on whether the transmission and reception are mechanical or 'statical.' Ayrton and Perry made some suggestions so far back as 1877 in connexion with the first system, but Fournier d'Albe's acoustic method of television (1924) was the first practical method. In connexion with the second system, many inventors—Leblanc, Nipkow, Belin, Ekstrom, Mihaly, Baird, Jenkins, and Alexanderson—have done valuable work. Baird transmitted outline images by television in 1925, and in 1926 he transmitted the human face. He is also the only person who has transmitted an image when the object is in total darkness. He has sent images across the Atlantic and to a ship at sea. He has transmitted colour television and shown stereoscopic television. A number of systems use mechanical methods for emission and statical methods for reception. B. Rosing uses a rotating prismatic mirror as an analyser and modulates by a photoelectric current the intensity of the cathode beam. In his 'telephote,' Dauvillier has developed the Rosing method into a practical instrument which has the merit of simplicity. The receiving apparatus consists of a cathode oscillograph. In NATURE for June 18, 1908, Mr. Campbell Swinton suggests a purely statical method which has many theoretical advantages.

Homogeneous Catalysis.

IN previous discussions held by the Faraday Society, the influence of surfaces and of light on the velocity of chemical actions has been reviewed, and it was with the object of obtaining a summary of the present position in respect to homogeneous reactions that a further discussion was held at Cambridge on Sept. 28 and 29.

The application of the term catalytic to any reaction occurring in homogeneous phases has been considered by some to be unsuitable, but provided that the original definition of Berzelius is not considered to be too broad for practical purposes, there is really little objection to this title. Our knowledge of the mechanism of many gas reactions has been made more complete chiefly by the work of Bodenstein and Hinshelwood; even the famous case of nitrogen pentoxide, which has defied the attacks of many investigators, has just been solved by Bodenstein, the pioneer in gas reaction technique. Yet, as the recent work of Kistiakowsky on the decomposition of hydrogen iodide reveals, it cannot be said that all is known as to the mechanism of these apparently simple reactions, what molecular target area or what activation by collision really is. No less than seven of the communications, including those of Drs. Bäckström, Christiansen, Dhar, Hinshelwood, Mardles, and Polanyi, were to a great extent devoted to what is undoubtedly one of the centres of interest at the present time, namely, the mechanism of chain reactions, and Messrs. Egerton, Garner, and Moureu took part in the discussion. These are of peculiar interest, in that they include a number of cases of reactions which proceed at great but measurable speed in a sort of no man's land between ordinary chemical reactions and explosions.

In general, a chain reaction, as indicated by its name, consists of a reaction of such a type that when one molecule of the reactants suffers reaction, it causes others to react. The number of molecules induced to react, that is, the chain length, may vary with the reaction from two or three molecules to several millions. Some investigators insist that there are in reality two problems to be solved, how a chain starts and how a chain is propagated. Others emphasise the importance of the propagation and believe that ordinary kinetic collision suffices to set a chain in action.

There are at least three different views as to the nature of the chain mechanism in these reactions; it is indeed possible that there are reactions conforming to each type. Historically, the oldest view is that of Nernst, in which an atom mechanism is postulated. This process can be visualised most readily by the following equations applicable to the combination of hydrogen and chlorine:

$$(1)\ Cl + H_2 \longrightarrow HCl + H$$
$$(2)\ H + Cl_2 \longrightarrow HCl + Cl.$$

Provided a chain has once started, it will on this view terminate when the atoms which form the chain links are fixed by some atom acceptor.

A second mechanism is that first advanced by Christiansen, in which it is suggested that the product of combination, containing as it does at the moment of formation both the original energy of activation and that resulting from combination, can excite a fresh molecule of one of the reactants. This suggestion has been applied by Bäckström, especially to the oxidation of benzaldehyde, and by Hinshelwood to the oxygen-hydrogen combination. It may be represented by the following equations:

$$(1)\ A + O'_2 \longrightarrow AO'_2$$
$$(2)\ AO'_2 + O_2 \longrightarrow AO_2 + O'_2.$$

It is worthy of note that inhibitors in these reactions which have been examined so exhaustively by Moureu and his co-workers frequently undergo oxidation themselves, suggesting that the breaking of the chain is effected by a reaction involving either the species AO'_2 or O'_2; likewise that these reactions occur not only in the gas phase, but also in solutions where numerous collisions with solvent molecules must take place between each chain link, if collision, and not radiation be the mechanism of propagation.

Finally, there exists the hypothesis of Semenoff, in which it is postulated that reaction centres are formed; these diffuse through the reacting system and act as initiators of chemical reaction until destroyed by chemical reaction or adsorption on the surface of the vessel. Some investigators believe that ions, which are possibly always formed in small quantities, especially in these reactions, are to be identified with the reaction centres of Semenoff. Many of those reactions increase rapidly in speed after a period of induction, and it is a necessary consequence that the chains must branch or that the concentration of reaction centres must increase during the reaction. A chemical formulation of this action may be made by postulating a dissociation of one of the reactants; for example:

$$A + O \longrightarrow AO'$$
$$AO' + O_2 \longrightarrow AO + 2O.$$

In this case each single molecule of active product AO' produces two oxygen atoms, giving rise to two fresh reactive molecules.

It was a pity that the limitations of time did not permit of a more adequate discussion of these reactions so that a serious attempt might have been made to reconcile the somewhat divergent opinions expressed.

The second part of the meeting was devoted to discussion of the mechanism of homogeneous catalysis in solution, and with the exception of an interesting paper by Prof. Boeseken in which he developed his well-known views on the application of the theory of molecular 'dislocation' to homogeneous reactions and cited an interesting application in the effect of catalysts on the polymerisation of acetaldehyde, the session was almost entirely confined to the question of the mechanism of reactions accelerated by hydrogen ions. In the discussion on this subject it was clear that the interest of the various investigators was directed to two different aspects of the problem. Some were clearly interested rather in the mechanism of the reaction, that is, the nature of the reacting complex and how it reacts, whilst others were more interested in the formal relationship between concentrations and reaction velocity. Both of these aspects are of course, to a certain extent, interdependent.

The investigations of Kendall on complex formation in ester–water, ester–acid, and acid–water systems may be said to be representative of the first group of investigations; we may include the views of Lapworth, Goldschmidt, and of F. O. Rice on the nature of the complexes formed by the hydrogen ion in aqueous and alcoholic media. The mechanism of the changes taking place in the action of mutarotation, where a sugar hydrogen ion complex is involved, has been elaborated by Brönsted and by Lowry. Emphasis is laid upon the amphoteric character of esters and sugars by Euler, but as observed by Brönsted, it is difficult to decide which are reactants and which products in a reversible system which can be denoted by the equation

$$G^- + H_2O \rightleftarrows HG + OH^-$$

where HG represents the sugar undergoing change.

The second group of investigations includes those in which attempts have been made to deduce the mechanism of these reactions from investigations on the formal relationship between concentrations and reaction velocity. The abnormal effects of strong acids as well as the effects of the addition of non-electrolytes have long been known and different interpretations of the accelerating effects have been advanced from time to time. In this discussion the summaries presented by Drs. Brönsted and Dawson respectively may be said to have been representative of the difference in point of view.

According to Dawson, the catalytic effect of an acid in aqueous solution may well be ascribed to the sum total of a number of several effects, those due to the acid and its components and of the medium. We may represent the velocity of such a reaction by an equation of the following type:

$$v = R_1H^{+} + R_2\bar{A} + R_3OH^{-} + R_4HA + R_5H_2O.$$

In this equation R_1 ... R_5 represent the specific activities of the various catalytic reactants. In orde to justify such an equation it is necessary to evaluate with accuracy the actual concentrations of the reactants; this is, in the case of electrolytes, no easy matter.

The view advanced by Brönsted and by Bjerrum is based upon the hypothesis of the existence of a quasi-complex or very unstable combination between reactants and catalyst and in mass equilibrium with them, the rate of change of this complex being so slow that the mass equilibrium is always established. This hypothesis leads to a very simple formulation of the reaction velocity:

$$v = kA \,.\, B \,.\, \frac{f_A f_B}{f_{AB}},$$

where f_A, f_B, f_{AB} are the activity coefficients of the reactants and complex. Whilst the theoretical evaluation of the relationship between the values of the activity coefficients and the concentrations in the case of electrolytes has not yet been completely solved, in spite of the progress achieved by Milner, Debye, and Hückel, yet their experimental determination by a number of methods does not present serious difficulties.

Brönsted and his co-workers have presented a number of investigations in which this formulation of the reaction velocity has been shown to be justified, and in the case of weak acid and salt mixtures the differentiation between primary and secondary kinetic salt effects is clearly exemplified, although the contribution by Harned and Akerlof demonstrated the complexity of the changes introduced when strong salt solutions are employed. The termination of the second day's discussion likewise proved too abrupt for either of the protagonists to make many converts to their views. ERIC K. RIDEAL.

New Buildings at the University of Leeds.

AN important stage in the ambitious but urgently necessary development scheme of the University of Leeds was reached on Tuesday, Oct. 2, when the foundation-stone of the new buildings was laid by Her Grace the Duchess of Devonshire.

After the ceremony, honorary degrees were conferred upon Her Grace The Duchess of Devonshire; Sir Albert Ernest Bain, chairman of the Finance Committee of the University; Mr. Alexander Campbell, chairman of the House and Estates Committee of the University; Mr. Morton Latham, Master of the Clothworkers' Company, 1912–13, and chairman of the Trusts and General Superintendence Committee of the Company, 1915–28.

The Mining Block is the first of the new buildings to be erected under the scheme for the enlargement of the University, which was designed by Messrs. Lanchester, Lucas, and Lodge, the winners of the architectural competition. The Department stands at the extreme north of the University's site and forms the right wing of the new University front as seen from Woodhouse Lane. Towards the cost of this building the Yorkshire Coal Owners' Association has contributed £25,000, and the Miners' Welfare Committee, £10,000. In accordance with a decision reached by the University authorities after very careful consideration, the front of this building, as well as the other buildings, will be of Portland stone. The back elevation will be of a good local brick with stone dressings. The building is 158 feet long. The general width of the building is 44 feet, but the central portion stands farther back in the form of a single storey glass-roofed shed which is capable of easy modification should the necessity arise owing to the development of the work of the Department. In common with the other buildings in the scheme, the block will have a flat roof, and the height of the parapet above ground level is 46 feet.

The work of construction is in the hands of Messrs. William Airey and Son (Leeds), Ltd. The building is in three main floors with a partial basement. In the basement a gallery is being built the full length of the building, especially designed for carrying out experiments in mine ventilation and similar problems. The ground floor accommodates the main laboratory, machinery room, crushing shed, and subsidiary rooms for stores and other purposes. The first floor houses laboratories for research, gas analysis, photometry, and general assay work, together with rooms for the staff. The second floor is devoted to the lecture theatre, drawing office, museum, and staff rooms.

The building will be heated by hot water, unconcealed panels being used partly in the ceilings and partly on the walls instead of the ordinary type of radiator. The department will be equipped with the most up-to-date apparatus and machinery designed to give students a complete scientific training before entry into this important branch of industry.

Cotton Growing in the Sudan.

THE Sudan Government, in collaboration with the Empire Cotton Growing Corporation, has issued the "Report for 1926–27 of Agricultural Work in the Sudan," in which the programmes of work for the following season are included. The Gezira Research Farm, which was established in 1918 in connexion with the irrigation project, comprises an area of more than 400 acres and possesses well-equipped laboratories. Considerable progress has been made during the year in bringing the farm up-to-date, and the establishment of two more stations where similar problems could be tested under different conditions is now suggested.

Cotton is the principal crop dealt with. In the chemical section the salt content, salt and moisture movement, and nitrate content of soils in relation to plant growth, are under investigation. The beneficial effect of heavy applications of gypsum on the permeability of Gezira soil is most marked, the uptake, penetration, and distribution of water being greatly improved; further work on this important question is in progress.

On the botanical side, the effect of climate and other factors such as time of planting on growth, is being

studied, a close correlation being found between excessive flower bud shedding and water deficiency. Length of lint may be influenced by meteorological conditions, low temperatures tending to induce the production of short lint. Longer lint also appears to be produced by the first formed bolls rather than those developed later. Blackarm and Root rot are the principal diseases, and white ants and thrips the chief insect pests of cotton under investigation.

Developments have been made in the plant breeding section, surveys being carried out to determine the districts most suitable for cotton growing in connexion with the establishment of variety testing stations. The actual composition of the soil appears to be of little importance provided it is capable of holding water and is reasonably penetrable by roots; the natural vegetation affords a fairly trustworthy index of the soil nature. Further, although a sufficiency of water is essential, areas subjected to flooding or undue surface erosion are unsuitable. Variety tests include both Egyptian and American type cottons, and spinning and grading tests are to be included in order to obtain information as to the relative value of the varieties to the grower.

University and Educational Intelligence.

CAMBRIDGE.—W. L. Edge and N. A. de Bruyne have been elected to fellowships at Trinity College.

LONDON.—A course of nine free public lectures will be delivered on Wednesdays, at 5.30 P.M., at King's College, on "The Indebtedness of Industry to Pure Science." The course begins on Oct. 17 with an introductory lecture by Sir Oliver Lodge. Succeeding lectures will deal with the rôle of chemistry in the life of the nation (Prof. A. J. Allmand); electrical science and industry (Prof. Ernest Wilson); the human factor (Dr. F. A. P. Aveling); physiology and national efficiency (Prof. R. J. S. McDowall); electrical communication and its indebtedness to physics (Prof. E. V. Appleton); the practical applications of zoology (Prof. Doris L. Mackinnon); the relation of botany to the grain, rubber, and cotton industries (Prof. R. Ruggles Gates); the influence of geology on modern life (Prof. W. T. Gordon).

Eng. Capt. Edgar C. Smith will deliver a course of three lectures in the Department of Engineering, King's College, at 5.30 P.M. on Oct. 16, 23, and 30, on "A Hundred Years of Naval Engineering." Students of the College Faculty of Engineering are admitted free, and other students at a reduced fee.

THE London School of Hygiene and Tropical Medicine is continuing its courses of lectures and practical demonstrations for employees of business firms and other bodies who are about to proceed to tropical and sub-tropical countries or are home on leave. These courses of instruction, in addition to providing simple rules for guidance in regard to preparation for life in the tropics and personal hygiene, also embrace a short account of some of the more common diseases, with advice in regard to measures of protection against such diseases, and some guidance in simple methods of self-treatment. One such course was given in July, and another has been arranged beginning on Oct. 22 at 11.30 A.M.; an evening course will also be given if there are sufficient applicants. Full particulars can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, 23, Endsleigh Gardens, Euston Road, W.C.1.

THE Royal Technical College, Glasgow, which many of our readers have no doubt visited while attending the meeting of the British Association, is now entering upon its hundred and thirty-third session. The College offers in its day classes four-year degree or diploma courses in all branches of engineering, naval architecture, chemistry, dyeing, sugar manufacture, metallurgy, and building, and a three-year course in textile manufacture. In connexion with its courses of study in engineering, which are held during the winter session, thus leaving students free to spend the intervening summers in works, the College has enlisted the co-operation of a large number of firms interested in the training of engineers. These firms allow selected apprentices facilities for carrying out a scheme of study conjoined with practical work. The studies of the first and second years are common to all branches of the degree courses in engineering, specialisation beginning in the third year in the civil, mechanical, electrical, mining, and chemical branches. By means of a scheme connecting the evening science classes conducted by local education authorities with the corresponding classes of the College, it has become possible for evening students within thirty miles of Glasgow to qualify for admission to third year and even more advanced courses at the College. Last session these affiliated classes were conducted in more than one hundred centres with an enrolment of 4101 students, exclusive of preparatory classes. The David Elder evening lectures in astronomy to be given in the College during the coming session will include courses on "Speculative Astronomy" by Prof. George Forbes, who hopes to develop a speculation as to the existence of an unknown planet outside the orbit of Neptune, beginning Oct. 17, and on "Modern Cosmologies," by the Rev. Hector Macpherson, beginning Jan. 9.

ENGLISH and American secondary schools are to form the subject of a co-operative study organised by the University of Pennsylvania in consultation with prominent educationists in both countries. The scheme, an outline of which appears in the June issue of *School Life*, the official organ of the United States Bureau of Education, embraces not only a comparison of the main facts and tendencies in the recent development of secondary education, but also a detailed comparative study of some thirty schools in each country, namely, twenty public high schools and ten private (independent) schools—five for boys and five for girls—in the United States, and twenty municipal and county secondary schools and ten independent schools in England. An outstanding feature of the scheme is the careful provision for obtaining a factual basis, as complete as possible, for useful comparison of the working out in actual practice of the systems of teaching in force in the two countries. In order to test the results of teaching, English pupils will take American examinations and vice versa, and papers will be graded both by English and American teachers independently; results will be compared and comments exchanged; questions, answer papers, and results of joint matriculation board examinations in England will be compared with those of the college board in America. Prof. E. D. Grizzell, of the University of Pennsylvania, will be in residence in England during the year 1928–29, and will actively participate in the study of the English schools. Any principal of a school of one of the types above mentioned who is interested in the study and, especially, any who would like to co-operate in the detailed plan for comparison of certain schools, is requested to write to Prof. Arthur J. Jones at the University of Pennsylvania, Philadelphia, Pa., U.S.A.

Calendar of Customs and Festivals.

October 14.

PACK FAIR.—At Sherborne, on the first Monday after Old Michaelmas Day. Popular tradition held that it originated at the termination of the building of the church, when all the workmen packed up their tools and held a fair or wake. Up till the beginning of the nineteenth century it was held in the churchyard. For some three or four weeks before the fair, processions of boys paraded the town blowing cows' horns. At twelve o'clock on Sunday night the fair was proclaimed by the ringing of the church bell and the blowing of cows' horns. The streets of the town were paraded and bonfires were lit. At four o'clock the bell rang for a quarter of an hour, and the sale of oxen, sheep, lambs, and pigs began, usually being completed by twelve o'clock. Tradesmen's yearly accounts were settled on this day, when they provided beef and ale for their customers.

October 16.

A customary tenure of Eskdale, Yorks, is connected by tradition with this day, on which, in the year 1140, William de Bruce, Ralph de Percy, and a freeholder Allotson, while bear-hunting, assaulted a hermit with fatal results. As a penalty they held their lands of the Abbot of Whitby on condition that on Ascension Eve they should come to the wood of Strayheads, and at sunrise an officer of the Abbot should blow his horn and deliver to each a certain number of stakes, 'stowers,' or 'yadders,' "to be cut with a knife of penny price," which they were to take on their backs to Whitby before nine o'clock, and at low water fix them at the brim of the water so that they stood for nine tides while the officer shall blow 'out on you' nine times for their crime.

October 17.

St. Ethelreda, daughter of Annas, king of the East Anglia, born about A.D. 630 at Ixning, on the borders of Cambridge and Suffolk. She took the veil, and though twice married by the insistence of her parents, maintained her vow. She is therefore styled "twice a widow and always a virgin." She founded a convent in the Isle of Ely, where she died in A.D. 679. Her name is said to have been corrupted to Auldrey or Audrey, the name given to the annual fair held at the Isle of Ely. The word 'tawdry' is said to be derived from the fact that showy lace and similar articles were sold at St. Audrey's; but an alternative derivation connects it with her death from a swelling in the throat as a retribution for having been addicted to wearing fine necklaces in her youth.

October 17 (O.S.).

This day is regarded in Morocco as favourable for beginning the operations of the first of the two ploughing seasons provided rain has fallen. Of the days of the week, some tribes maintain that Thursday is more favourable than Sunday. With some, only the leading man of the village begins on that day. Certain rites, varying in detail from tribe to tribe, must be performed. A loaf of bread specially baked is taken to the field and either eaten by all present before ploughing begins, or after it has rested between or on the horns of the ox during the day; sometimes it is broken with the plough beam. Before sowing crops, excepting barley, some of the seed is picked up by the plough point, cooked and eaten. Pomegranate juice is sometimes squeezed on the horns of the oxen or rubbed on the neck and back to avert the evil eye. Among the Aiț Yúsi, as the farmer is about to set out he says, "Come on and fetch water, O women," and they reply, "O wheat and barley, O Farmer." This is repeated three times. No water is fetched, but the dialogue in itself is supposed to ensure adequate rain and plentiful crops. Pomegranates are crushed on the plough point so that the grain may be as plentiful as the pips. Special magical efficacy is ascribed to the ceremonial meal as a means of securing the well-being of the crops. It is customary at the first ploughing to promise the grain from a certain portion of the field to a certain saint. This grain is presented to the descendants of the saint, who divide it with the scribes of his shrine.

With the Morocco ceremonial may be compared that of the Bhainas of the Central Provinces of India, which is performed at the shrine of Thakurdeo the day before the sowing begins. The priest makes an offering and repeats a charm, then kneeling, strikes the earth seven times with a ploughshare, and sows seven handfuls of rice, sprinkling water over the seed. Then the villagers walk seven times round the altar in pairs, one turning up the earth with a ploughshare, the other watering the seed.

October 18.

ST. LUKE'S DAY.—On this day a fair known as Horn Fair used to be held at Charlton, Kent. The name of the fair was derived from the custom of carrying or wearing horns, which were also displayed conspicuously on each stall. A reference to this custom dates from the year 1593. A long pole with reins woven on it was put on the shore of the river. It was at one time the custom for a procession to go from Bishopsgate Street to Charlton, where the procession marched round the church three times. It included a king, a queen, a miller, a councillor, and other characters, all wearing horns in their hats. On Blackheath females were whipped with furze and other 'indecencies' performed, while it was also customary for men to go to the fair in women's clothes. There is also mentioned a procession from Cuckold's Point, near Deptford, through Greenwich to Charlton. At the beginning of the nineteenth century, when the fair was no longer held on the traditional site of the green opposite the church, but in a private field, horns still continued to be the most prominent article on sale, and most of those at the fair wore masks or dressed as women or some grotesque character.

The fair is evidently an institution of great antiquity. Early writers are prone to regard the fair as an exploitation of the usual jest, while others connect it with the ox, the symbolic animal of St. Luke. While the pole may well have a phallic significance and the whipping of women and other 'indecent' customs on Blackheath are doubtless fertility rites, it is possible that the horns here, as well as the cow horns used in connexion with Pack Fair at Sherborne may be connected with cattle sacrifices of the early winter festival.

A divinatory practice for marriage on St. Luke's Day—"fitter for this purpose than St. Agnes"—which strongly suggests its origin in the charm or love potion, is recorded. "Take marigold flowers, a sprig of marjoram, thyme, and a little wormwood, dry them before a fire, rub them to powder, then sift through a fine piece of lawn; simmer these with a small quantity of virgin honey in white vinegar over a slow fire; with this anoint your stomach, breast, and lips lying down, and repeat these words:

> 'St. Luke, St. Luke, be kind to me,
> In dreams let me my true love see.'"

The charm goes further than most, for the character of the husband will be indicated, that is, whether he will be loving and true or unfaithful.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 3.—**G. Bigourdan**: The unification of radiotelegraphic time signals. A suggested modification of the time signals, giving an easy identification of each minute.—**Paul Vuillemin**: Relations of the conidial apparatus with the mycelium of *Aspergillus*.—**N. Iarotzky**: A method for obtaining a maximum of short wave ultra-violet rays. A modification of the quartz mercury vapour lamp, in which high tension currents of 80,000 volts are employed. By altering the resistance a mercury spectrum can be obtained giving radiations of 253 $\mu\mu$. The special advantages for therapeutic work are indicated.—**J. Savornin**: The coal basin of Djerada (Eastern Morocco). The coal seam described is anthracitic, and contains 15 per cent of ash.—**Jules Welsch**: Contribution to the knowledge of the Jurassic fauna of Poitou. Oxford-Argovian stage.—**E. Poyarkoff**: The fertility formula in the silkworm. The difference between the average weight of a female cocoon and a male cocoon in the silkworm is the average weight of eggs laid by the female. **F. Rathery, R. Kourilsky**, and **Mlle. Y. Laurent**: The reciprocal influence of folliculin and of insulin on the glycæmia of ovariectomised dogs.—**Et. Burnet** and **D. Olmer**: The transmission of the exanthematous fever of Marseilles to the lower apes.

Sept. 10.—**G. Bigourdan**: The observatory of Delambre at Bruyères (Seine-et-Oise).—**Constant Lurquin**: Some algorithms characteristic of probability.—**Miécislas Biernacki**: Integral functions.—**Farid Boulad Bey**: The geometrical determination of the lines of influence of forces in continuous beams of any form.—**Nemours-Auguste** and **Martin**: The relation between fertility and high frequency in radio telegraphy stations. It has been suggested that there is a tendency for operators in wireless telegraphy stations to become sterilised. Experiments on mice exposed to high frequency currents for fifteen days continuously negative this view: the fertility of the mice was unaffected by the treatment.—**Philippe Fabre**: The kinetic theory of the neuro-muscular stimulation by short waves.—**Bordas** and **Neveu**: Public baths. A discussion of the possibilities of infection in public baths. The authors regard this danger as a very real one, and make suggestions as regards the purification of the bath water.—**Et. Burnet** and **J. Bance**: The properties of purified streptococcus-scarlatinous toxin.

CAPE TOWN.

Royal Society of South Africa, Aug. 15.—**Sir Thomas Muir**: Note on Brioschi's treatment of the product of two sums of eight squares.—**W. A. Jolly**: On the action current staircase in skeletal muscle. It is a familiar fact that the twitches of a muscle stimulated by a series of stimuli exhibit at first a progressive increase in size, and this is usually regarded as demonstrating that previous stimulation has an improving effect on the muscle's responsive power. The present paper is concerned with the staircase obtained in the first few responses when the action currents of the muscle are recorded as indicators of its activity. Records have been obtained from the tibialis anticus and gastrocnemius muscles of the pithed *Xenopus* (the S.A. clawed frog or toad) on indirect stimulation through the uncut and also the severed sciatic nerve by means of submaximal break induction shocks. The rates of stimulation employed are 15 and 20 per second. After the staircase phenomenon had been recorded in both muscles by stimulation of the uncut sciatic nerve, the nerve was severed in the thigh central to the stimulating electrodes which were left in place. This procedure, which is known to increase the nerve's irritability, abolishes the staircase phenomenon, suggesting that we are dealing at first with a tissue of slightly depressed irritability and that stimulation improves its condition and increases its responsiveness, so giving rise to the staircase. The shortening of the latent period is consistent with this.—**E. O. Engel**: Notes on two larvæ of South African Diptera belonging to the families Leptidæ and Asilidæ. *Lampromyia sericea*, Westwood, is the larva of a Leptid fly of the sub-family Vermileoninæ, a group represented also in southern Europe and the southern United States. The larvæ of this group make conical pits in loose sandy soil, exactly like the pits of ant-lions and serving in the same way for the capture of ants and other terrestrial insects. *Hyperechia nigripennis* Wied. belongs to the family Asilidæ (the Robber-Flies). Most of the Robber-Flies are long-bodied and long-legged and use their spiked hind legs in capturing other insects on the wing; but *Hyperechia* and other members of the sub-family Laphriinæ bear a striking superficial resemblance to certain of the Carpenter Bees, and their larvæ are parasitic in the nests of the bees which they mimic. The larval mouth-parts are much reduced, presumably in correspondence with the parasitic mode of life. **Louis P. Bosman** and **H. Zwarenstein**: The effect of temperature on the blood sugar level and the glucose tolerance in *Xenopus Lævis*. The blood sugar levels at 5°, 10°, 20°, 25° C., are respectively 69, 57, 44·2, 37 mgm. per 100 c.c. 1 c.c. of 2 per cent solution of glucose (=20 mgm.) was injected into the dorsal lymph sac. This is equivalent to the ingestion of 50 gm. glucose by a man weighing 70 kgm. in carbohydrate tolerance tests. The tolerance curve at 5° C. shows a maximum of 124 mgm. 3 hours after injection and returns to normal 4 hours later. At 10° C.: max. of 119 mgm. ½ hour after injection, normal 5½ hours later. At 20° C.: max. of 173 mgm. ½ hour after injection, normal 6½ hours later. The corresponding figures for man are: normal blood sugar 90 mgm. per 100 cc.; max. of 180 mgm. ½ hour after ingestion of 50 gm. glucose; normal 1 hour later.—**E. J. Wayland**: An account of a pebble industry in the Transvaal. Various artefacts found at Belfast in the Transvaal fall into two industrial groups. The first consists of a number of artificially chipped quartzite pebbles; the second has Mousterian affinities.

LENINGRAD.

Academy of Sciences. *Comptes rendus*, No. 16-17.—**F. Loewinson-Lessing**: Magnetisation as a method for the rapid field determination of iron in bauxites. Artificial magnetisation may be used as a method of quick approximate determination of the content of ferric oxide in bauxites, perhaps also in certain clays and in limonite ores.—**S. Jakovlev**: The Tikhvin sands. An area of sand dunes in the Cherepovetz province is described. The dunes were formed probably before the xerothermic period, but shortly after the Glacial period.—**S. Ognev**: A new form of the steppe cat from the Transcaspian region. Description of *Octolobus manul ferrugineus* sbsp. n. from the Kopet-Dagh mountains in Transcaspia.—**N. N. Jakovlev**: Heredity of acquired characters in the palæozoic corals *Rugosa*. These corals were fixed by one side, and as a consequence their calyx grew unequally. This unequal growth persisted even when the animal had no need to grow in that way; thus an acquired character was inherited.—**N. N. Jakovlev**: Teratology and morphogeny of the abrachiate crinoids. Seven abnormal specimens of *Hemistreptacron abrachiatus* were found amongst nearly a thousand

specimens examined, the anomalies mainly presenting such characters as may be due to an interruption in the individual development; the forms resulting are interesting from the point of view of the ontogeny of the genus.—**D. A. Grave**: The method of magnetic detection of iron ores suggested by Steklov is criticised from the point of view of mathematics, the argument being based on Gauss's theory of earth magnetism.—**P. Schmidt**: A rare Japanese deep-sea fish, *Ereunias grallator*, Jordan and Snyder. Detailed re-description and measurements of the species, based on a specimen in the Academy collection, this being the third known example of the species.—**B. Lichkov**: Contribution to the geological history of the Polesie. Geomorphological studies in the Polesie lead to the conclusion that during the quaternary period there existed on the Dnieper, Pripet, and probably on other South Russian rivers wide inundation areas reaching the area of glaciation. This disposes of the existing idea that desert conditions prevailed in the Polesie during the quaternary period.—**C. Markov**: Ancient continental dunes in the north-west part of the Leningrad province.—**A. Leskov**: *Gagea granulosa Turcz.* Re-description of the species and its distribution in Russia.—**A. A. Birula**: Lower course of the Volga as a zoogeographical frontier. A central-Asian scorpion *Buthus eupeus thersites* C. Koch is recorded for the first time from the right (western) side of the Volga; since that river is an absolutely impassable barrier for scorpions, the question arises how the species arrived there, and it is suggested that the lower course of the Volga may have changed relatively recently, shifting to the east as compared with the former bed, which may have coincided with the basin of the Sarpa lakes.—**M. Korsakova**: Studies in the chemistry of denitrification processes. Denitrifying bacteria may be divided into two groups: some can develop at the expense of nitrates, while others require the presence of ammonia, nitrogen, or amine nitrogen. For the bacteria of the second group, amino-acids serve also as a source of carbon; these bacteria possess a disamidase which is able to split up the amine nitrogen.—**V. Romanovskii**: The statistical criteria of group characters. Some remarks and supplements to Pearson's theory of coefficients of racial likeness.

Comptes rendus, No. 18-19.—**V. Jasnitskii**: Some results of the hydrobiological investigations in Lake Baikal during the summer of 1925. Benthos and plankton organisms were studied; bottom samples were taken and a map of the distribution of the bottom flora of the southern part of the lake was prepared.—**Th. Pleske**: Description of a new species of the genus *Eulalia* (Diptera, Stratiomyidæ) from Korea. *Eulalia coreana* sp. n. is described and a key to the species of the subgenus *Zoniomyia* given.—**V. Vlodavec**: Two new deposits of alkaline rocks in the Kola peninsula. The peninsula is unusually rich in alkaline rock deposits, there being now ten separate deposits known. Analyses of rocks are given.—**D. Serdjutchenko** and **P. Tchirvinskii**: The palygorskite and pyrite from the Trudov mine in the Donetz basin. The palygorskite has the formula $K_{10}Mg_2Al_8Si_7O_{24}.4H_2O$.—**J. Beliajev**: Classification of the points of longitude determined by astronomical observations. Eight different classes of longitude points are recognised and the permissible limits of error for each class stated.—**B. Kuzmin**: On a problem of Gauss.—**O. Tchekanovskaya**: A modification of the abdominal extremities in *Diogenes varians* Heller (*D. pugilator* Roux) caused by parasitic castration. Hermit crabs, *Diogenes varians*, parasitised by *Peltogaster*, often develop reduced extremities; castrated males in many cases exhibit a tendency to the reduction of the specifically male appendages and to the development of the female ones.—**G. I. Poplavskaya**: A contribution to the flora of the Crimea. A list of species of plants new to the Crimea, and a description of two new species, *Phelipæa helenæ* and *Scrophularia exilis* spp. nn.—**N. Prokopenko**: A seam of nakrite in the eruptive rocks of Totaikoi near Simferopol. Geo-morphological and mineralogical description of the nakrite.—**P. I. Lebedev**: Alutinisation of lavas of Alagoez in Armenia. Both in the crater of Alagoez and on its slopes alutinised lavas are common. There are several varieties of them and their chemical analyses are given.—**F. I. Lebedev**: Contribution to the mineralogy of the Tetjuche deposits of silver, zinc, and lead. Analyses and mineralogical description of smithsonites from two deposits in the Russian Far East.

Official Publications Received.

BRITISH.

Northampton Polytechnic Institute, St. John Street, London, E.C.1. Announcements for the Session 1928–1929 giving particulars of the Evening Courses in Applied Optics. Pp. 26. Announcements for the Session 1928–1929 giving particulars of the Day Courses in Applied Optics. Pp. 20+4 plates. Announcements for the Session 1928–1929 giving particulars of the Evening Classes in Applied Chemistry. Pp. 24. Announcements for the Session 1928–1929 giving particulars of the Evening Classes in Electrical Engineering. Pp. 44. Announcements for the Session 1928–1929 giving particulars of the Evening Classes in Civil and Mechanical Engineering. Pp. 44. Announcements for the Session 1928–1929 giving particulars of the Engineering Day College. Pp. 41+7 plates. (London.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1121 (Ae. 294): The Experimental Determination of the Trajectory of Aircraft Bombs. By H. E. Wimperis. Pp. 25+10 plates. 1s. 6d. net. No. 1138 (M. 53): The Determination of the Elastic Moduli of a Mild and a Medium Steel. By H. E. Smith and H. L. Cox. (E.F. 192 and A.) Pp. 7+8 plates. 6d. net. (London: H.M. Stationery Office.)

Annual Report of the Executive Council of the National Institute for the Blind for the Year ended March 31st, 1928. Pp. 78. (London.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester. Session 1928–29. Pp. 320. (Manchester.)

University of Cambridge. Department of Agriculture: Farm Economics Branch. Report No. 10: An Economic and Financial Analysis of Fifteen East Anglian Farms, 1926–27. By R. McG. Carslaw and W. H. Kirkpatrick. Pp. 22. (Cambridge: W. Heffer and Sons, Ltd.) 1s. net.

Air Ministry. Aeronautical Research Committee. Reports and Memoranda. No. 1141 (Ae. 312): Report on the Development of a Hot-Wire Rate of Descent Meter. By G. W. H. Gardner and F. W. Meredith. (T. 2540.) Pp. 16+10 plates. 1s. net. No. 1157 (Ae. 322): On the Horizontal Flight of a Helicopter. By H. Glauert. (T. 2612.) Pp. 12+1 plate. 9d. net. (London: H.M. Stationery Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 381, September. Pp. 909–1004+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Memoirs of the Geological Survey of India. Vol. 49, Part 2: The Former Glaciation of the East Lidar Valley, Kashmir. By Lieut.-Col. John L. Grinlinton. Pp. iv+289-388+plates 12-35. (Calcutta: Government of India Central Publication Branch.) 7.12 rupees; 13s.

Journal of the Indian Institute of Science. Vol. 11A, Part 7: i. Estimation of Iodine in Soils, by Roland V. Norris and D. A. Rama Rao; ii. Carbohydrate Changes during the Ripening of Plantains, by S. Ranganathan, Jr. Pp. 75-83. 12 annas. Vol. 11A, Part 8: i. Oxidation of Sulphur in Suspensions of Activated Sludge and its Influence on the Solubilisation of Mineral Phosphates, by C. V. Ramaswami Ayyar, T. S. S. Perumal and Roland V. Norris; ii. Studies in the Proteins of Indian Foodstuffs, Part 2: The Proteins of Ragi (*Eleusine coracana*); Eleusinin, the Alcohol-soluble Protein, by Nuggehalli Narayana and Roland V. Norris. Pp. 85-95. 1 rupee. (Bangalore.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), Nos. 1-8. 1: Award of the Boyle Medal for Pure Science to William Ringrose Gelston Atkins, 1928; Report of the Committee of Science and its Industrial Applications; 2: Award of the Boyle Medal for Applied Science to Walter Ernest Adeney, 1928; Report of the Committee of Science and its Industrial Applications; 3: A Simple Form of Photo-electric Photometer, using a Neon Lamp to Measure the Current, by Dr. J. H. J. Poole; 4: Influence of Temperature on Response to Electrical Stimulation, by Prof. Henry H. Dixon and T. A. Bennet-Clark; 5: *Salpingium palinorsum*, a new Carboniferous Coral, by Dr. Louis B. Smyth; 6: Report of the Irish Radium Committee for the Year 1927, by Maurice R. J. Hayes and Dr. Walter C. Stevenson; 7: Spectrographic Analyses of Irish Ring-Money and of a Metallic Alloy found in Commercial Calcium Carbide, by Dr. A. G. G. Leonard and P. F. Whelan; 8: "Blossom-Wilt" of Apple Trees and "Wither-Tip" of Plum Trees, with special reference to two Biologic Forms of *Monilia cinerea*, Bon., by Dr. C. Boyle, M. Murphy and Dr. H. A. Cummins. Pp. 76+5 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6s.

The East Anglian Institute of Agriculture, Chelmsford (Essex Agricultural Committee). Calendar 1928–1929. Pp. 50+xxii. (Chelmsford.)

Board of Education. Report of the Departmental Committee on Examinations for Part-time Students. Pp. viii+74. (London: H.M. Stationery Office.) 1s. net.

North-East Coast Institution of Engineers and Shipbuilders. Handbook. Pp 80. (Newcastle-upon-Tyne.)

Hull Municipal Museums. 12 Pictorial Postcards of Wilberforce House (with Descriptions). Set B. (Hull.) 1s.

Royal Commission on National Museums and Galleries. Interim Report, dated 1st September 1928. (Cmd. 3192.) Pp. 64+3 plans. (London: H.M. Stationery Office.)

University of London: Board to Promote the Extension of University Teaching. University Extension Lecture Courses and University Tutorial Classes, Session 1928–29. Pp. 39. (London.)

The Institution of Water Engineers. Average and Extreme Seasonal Rainfall over the British Isles. By Dr. John Glasspoole. Pp. 24. (London.)

Proceedings of the Physical Society: from December 1927 to August 1928. Vol. 40. Pp. xxii+229-349. (London: Fleetway Press, Ltd.) 7s. net.

The Institution of Mining and Metallurgy. List of Members (with Topographical Index), Constitution and By-Laws and Royal Charter of Incorporation. Pp. 156. (London.)

Centenary of the Hot Blast. Life of James Beaumont Nelson, F.R.S., Inventor of the Hot Blast. Compiled by Thomas B. Mackenzie. Pp. [illegible]+4 plates. (Glasgow: West of Scotland Iron and Steel Institute.)

Nickel, Brass and Bronze. Series D, Paper No. 1: The Use of Nickel in Non-Ferrous Castings. Pp. 9. (London: The Bureau of Information on Nickel, Ltd.)

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1927. By F. W. South. Pp. ii+18. (Kuala Lumpur.)

Journal of the Indian Institute of Science. Vol. 11A, Part 9: i. Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn.), Part 2. Analysis of Leaves from Healthy and Spiked Trees, by A. V. Varadaraja Iyengar; ii. Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn.), Part 3. Physico-Chemical Study of the Leaf-Sap, by A. V. Varadaraja Iyengar. Pp. 97-109. (Bangalore.) 1 rupee.

Union of South Africa. Department of Mines and Industries: Geological Survey. The Geology of the Country between Grahamstown and Port Elizabeth: an Explanation of Cape Sheet No. 9 (Port Elizabeth). By Dr. S. H. Haughton; with a Chapter on Underground Water Resources of the Uitenhage Region, by Dr. Alex. L. du Toit. Pp. 45. [illegible] (with Map). Memoir No. 19: The Coal Resources of the Union of South Africa. Vol. 3: The Coalfields of the Eastern and South-Eastern Transvaal, Springbok Flats, Waterberg, Zoutpansberg, and of the Cape Province. By W. J. Wybergh. Pp. 176. 10s. (Pretoria: Government Printing and Stationery Office.)

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended 31st March 1928. (M.O. 308.) Pp. 46. (London: H.M. Stationery Office.) 1s. 6d. net.

The Physical Society. List of Officers and Fellows, September 15, 1928. Pp. 28. (London.)

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1928; with Appendices. Pp. 45. (London: H.M. Stationery Office.) 1s. 6d. net.

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Period ended 31st March 1928; with Report of the Director of Fuel Research. Pp. vi+70. (London: H.M. Stationery Office.) 1s. 3d. net.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 23 and 24: Survey of the Waste Land of North County Wicklow suitable for Afforestation, by S. Leonard; A Suggested Method for the Utilisation of Seaweed, by Dr. Thomas Dillon and Edward F. Lavelle. Pp. 391-413+plate 27. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 3s.

New South Wales: Department of Mines. The Mineral Industry of New South Wales. By E. C. Andrews and the Staff of the Geological Survey. Edited by F. S. Mance. Pp. v+432+40 plates. (Sydney: Alfred James Kent.) 7s. 6d.

Journal of the Chemical Society: containing Papers communicated to the Society. September. Pp. v+2305+2630+xii. (London: Gurney and Jackson.)

Birkbeck College (University of London). The Calendar for the Year 1928–29. (106th Session.) Pp. 237. (London.)

County Council for the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1928. Pp. 25. (Wakefield.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1160 (Ae. 325): The Resistance of the International Airship Models measured in the Wind Tunnel of the Royal College of Science, South Kensington, S.W.7. By Prof. F. T. Hill and T. Tanner. (T. 2590.) Pp. 9+6 plates. 9*d.* net. No. 1161 (M. 56): Report on the Drop of Stress at Yield in Armco Iron. By Dr. A. Robertson and A. J. Newport. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 203.) Pp. 7+20 plates. 9*d.* net. (London: H.M. Stationery Office.)

Southern Rhodesia: Geological Survey. Bulletin No. 13: Reports by the Mining Geologist, February 1927 to May 1928. By F. E. Keep. Pp. 79+4 plates. (Salisbury, Southern Rhodesia.)

Department of Agriculture: Trinidad and Tobago. Flora of Trinidad and Tobago. Vol. 1, Part 1: Ranales. By R. O. Williams. Pp. 22. 1s. Vol. 2, Part 1: Rubiales. By R. O. Williams and Prof. E. E. Cheesman. Pp. 48. 2s. (Trinidad, B.W.I.)

Mines Department: Safety in Mines Research Board. Paper No. 44: The Safety in Mines Research Laboratories, Sheffield; a Description. Pp. 19+11 plates. (London: H.M. Stationery Office.) 6*d.* net.

Nigeria. Annual Report on the Agricultural Department for the Year 1927. Pp. 18. (Ibadan.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 3, No. 4, October. Pp. 271-358. (Cambridge: At the University Press.)

FOREIGN.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1927. Pp. 65. Journal du Conseil. Vol. 3, No. 2. Pp. 135-291. (Copenhague: Andr. Fred. Høst et fils.)

Société des Nations (League of Nations): Institut International de Coopération Intellectuelle. Bulletin des relations scientifiques. 3e année, No. 3, Août. Pp. iv+121-166. (Paris: Les Presses universitaires de France.) 8 francs.

International Hydrographic Bureau. List of Lifesaving Stations of the World, with their Equipment and Geographical Positions. By Rear-Admiral A. P. Niblack. Second edition. Pp. 87. (Monaco.) 7·65 francs.

Conseil International de Recherches: Union Géodésique et Géophysique Internationale. Section d'Océanographie. Bulletin N. 11: Réunion plénière de la Section (Prague, Septembre 1927). Pp. 78. (Venezia.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Chemical Section, Bulletin No. 78: Bordeaux Mixture; its Adhesive Power under Egyptian Climatic Conditions. By Dr. R. R. Le Geyt Worsley. Pp. 5. (Cairo: Government Publications Office.) 5 P.T.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 48: Report of the Transition Area and Baltic Area Committees concerning the Question of Protection of Plaice, Salmon and Sea-Trout in the Belt Sea and the Baltic. Pp. 125. (Copenhague: Andr. Fred. Høst et fils.)

The Rockefeller Foundation. Annual Report, 1927. Pp. xi+385 (32 plates). (New York City.)

Air Temperature in Tyôsen (Korea). Compiled by the Meteorological Observatory of the Government-General of Tyôsen. Pp. ii+343+50 charts. Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1925. Pp. iv+154. (Zinsen.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 21: Present-Day Law Schools in the United States and Canada. By Alfred Zantzinger Reed. Pp. xv+598. (New York City.)

Forty-second Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1924–1925. With accompanying Papers: Social Organization and Social Usages of the Indians of the Creek Confederacy, by John R. Swanton; Religious Beliefs and Medical Practices of the Creek Indians, by John R. Swanton; Aboriginal Culture of the Southeast, by John R. Swanton; Indian Trails of the Southeast, by William Edward Myer. Pp. vii+900+16 plates. (Washington, D.C.: Government Printing Office.) 2.75 dollars.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 571: Surface Water Supply of the United States, 1923. Part 11: Pacific Slope Basins in California. Pp. viii+431. 50 cents. Water-Supply Paper 576: The Ground-Water Resources of Mississippi. By Lloyd W. Stephenson, William N. Logan and Gerald A. Waring; with Discussions of the Chemical Character of the Waters, by C. S. Howard. Pp. vii+515+12 plates. 90 cents. Water-Supply Paper 582: Surface Water Supply of the United States, 1924. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+66. 10 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the National Research Council. No. 63: Selected Topics in Algebraic Geometry. Report of the Committee on Rational Transformations. Pp. 395. (Washington, D.C.: National Academy of Sciences.) 4 dollars.

Transactions of the San Diego Society of Natural History. Vol. 5, No. 13: A new Fox from the Cape Region of Lower California, Mexico. By Laurence M. Huey. Pp. 203-210+plates 25-26. (San Diego, Calif.)

Sitzungsberichte der Physikalisch-medizinischen Sozietät zu Erlangen. Herausgegeben von Oskar Schulz. Band 58-59, 1926–1927. Pp. xx+435. (Erlangen: Max Mencke.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 7: Termites of the Belgian Congo and the Cameroon. By Alfred Edwards Emerson. Pp. 401-574+plates 20-38. (New York City.)

Skrifter utgitt av Det Norske Videnskaps-Akademi i Oslo. Matematisk-naturvidenskapelig klasse, 1928, No. 4: Untersuchungen über die Kristallstruktur von Sesquioxyden und Verbindungen ABO_3. Von William Houlder Zachariasen. Pp. 165. (Oslo: Jacob Dybwad.) 12.00 kr.

Japanese Journal of Chemistry: Transactions and Abstracts. Vol. 2, No. 4. Pp. 109-148. Vol. 3, No. 1. Pp. 70. Vol. 3, No. 2. Pp. 71-108. Vol. 3, No. 3. Pp. 109-163. (Tokyo: National Research Council of Japan.)

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 9: Schools and Classes for the Blind, 1926–27. Pp. 7. 5 cents. Bulletin, 1928, No. 10: Industrial Schools for Delinquents, 1926–1927. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.)

Conseil International de Recherches, Union Géodésique et Géophysique Internationale: Section Internationale d'Hydrologie scientifique. Bulletin N. 10: Études poursuivies dans les différents pays sur les débits solides des cours d'eau (Égypte, France, Italie). Pp. 44. Bulletin N. 11: Rapports sur l'état de l'hydrologie, Tchécoslovaquie. Pp. 16. Bulletin N. 12: Réunion plénière de la Section (Prague, Septembre 1927). Pp. 67. (Venezia.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 178: Michigan Raspberry Diseases. By C. W. Bennett. Pp. 52. Technical Bulletin No. 92: A Study of the Cause of Honey Fermentation. By E. W. Fabian and R. I. Quinet. Pp. 41. (East Lansing, Mich.)

Occasional Papers of the California Academy of Sciences. No. 16: The Amphibians of Western North America: an Account of the Species known to inhabit California, Alaska, British Columbia, Washington, Oregon, Idaho, Utah, Nevada, Arizona, Sonora, and Lower California. By Joseph R. Slevin. Pp. 152+23 plates. (San Francisco, Calif.) 3 dollars.

Proceedings of the Imperial Academy. Vol. 4, No. 7, July. Pp. xxv-xxvii+319-442. (Tokyo.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 156: Effect of a Circular Hole on the Stress Distribution of a Beam under Uniform Bending Moment. By Zirô Tuzi. Pp. 65–89. 45 sen. No. 157: Untersuchung der Dekahydrochinolinderivate. Mitteilung 4: Über den Hofmannschen Abbau des Octohydro-α-methylindols. Von Shin-ichiro Fujise. Pp. 91–98. 20 sen. (Tôkyô: Iwanami Shoten.)

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 11: Educational Surveys. By Arthur J. Klein, Walter S. Deffenbaugh, Timon Covert and Edith A. Lathrop. Pp. 67. (Washington, D.C.: Government Printing Office.) 15 cents.

CATALOGUES.

A Catalogue of Mathematical and Physical Books. (No. 168.) Pp. 68. (Cambridge: Galloway and Porter, Ltd.)

A Catalogue of Scientific Books: including a portion of the Ornithological Library of Dr. A. H. Evans. (No. 444.) Pp. 32. (Cambridge: Bowes and Bowes.)

Diary of Societies.

FRIDAY, OCTOBER 12.

DIESEL ENGINE USERS' ASSOCIATION (at 19 Cadogan Gardens, S.W.), at 5.30.—S. B. Freeman: Marine Oil Engines.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-on-Tyne), at 7.15.—L. H. Hedley: Chairman's Address.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. Squirrell: The Use of Instruments in the Boiler-House.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—R. D. Barklie: Alternating Current Electrolysis.—Dr. E. B. Sanigar: Sodium Cyanide in Silver Plating.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—Dr. V. G. Jolly: Pigment and Vehicle.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—C. H. Walker: Some Recent Changes in the Incidence of Ophthalmic Diseases (Presidential Address).—E. Wolff: Report on a Case of a Large Implantation Cyst of the Conjunctiva, with Illustrations and Pathological Report.

SATURDAY, OCTOBER 13.

MINING INSTITUTE OF SCOTLAND (at Heriot Watt College, Edinburgh), at 3.—D. C. Gemmell and J. Heron: Some Impressions of German Mining.—Discussion on following Papers:—J. A. B. Horsley: Design and Maintenance of Flame-Proof Enclosures, with Special Reference to Coal Face Machinery.—W. Maurice: More about Better Mine Lighting.—J. M. Williamson and J. Bilsland: An Experience of Machine Mining in a Highly Inclined Seam.—G. W. Smith: A Trial Bore for Oil in South Africa, and the Results.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Northumberland and Durham Branch) (at Armstrong College, Newcastle-upon-Tyne), at 3.—Dr. H. Louis: Protection against Damage by Subsidence.

PHYSIOLOGICAL SOCIETY (in Physiology Department, Guy's Hospital Medical School), at 4.—G. P. Crowden: The Recovery-Production of Adrenalin.—H. I. Maister, W. H. Ogilvie, and Dr. M. S. Pembrey: Excretions of the two Kidneys under Different Conditions.—Dr. M. S. Pembrey: Weights of Hearts of Fœtal and Newly Born Animals.—A. St George Huggett: The Placental Glycogen.—C. M. Burns: The Influence of Guanidine Salts on the Growth and Composition of Bone.—Dr. E. D. Adrian and D. W. Bronk: Apparatus for Demonstrating Nerve and Muscle Action Currents.—Demonstrations:—R. A. Collier: A Simple Photographic Attachment to an Ordinary Drum.—Prof. R. J. S. McDowall: (*a*) A New Volume Recorder; (*b*) A Simple Apparatus for Micro-adjustment in all Directions.—Dr. E. D. Adrian and D. W. Bronk: Impulses in Single Motor Nerve Fibres or in Small Groups of Muscle Fibres.—K. E. Harris, T. Lewis, and J. Vaughan: Urticaria produced by Cold.—B. T. Squeles: The Ultra-Violet Fluorescence of Urine.—E. P. Poulton, W. R. Spurrell, and E. C. Warner: A Convenient Form of Apparatus for Measuring the Respiratory Exchanges of Carbon Dioxide and Oxygen over Short or Long Periods.—H. D. Kay: Class Experiments on Enzymic Synthesis.

MONDAY, OCTOBER 15.

SOCIETY FOR THE PRESERVATION OF THE FAUNA OF THE EMPIRE (at Zoological Society of London) (General Meeting), at 4.—Exhibition by Mrs. C. Akeley of a film dealing with Gorilla Life.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 5.45.—Miss E. Wheeler: Backwardness in Arithmetic.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 7.—W. J. Jones: Electric Light in Factories as it affects Production and Hygiene.

BRADFORD ENGINEERING SOCIETY (at Bradford Technical College), at 7.30.—R. A. Thwaites: Electricity Supply in Rural Areas.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Branch—London and District) (at Borough Polytechnic), at 7.30.—Debate on Steam *v.* Hot Water Heating.

HUNTERIAN SOCIETY OF LONDON, at 7.30.—Dr. A. Westerman: Gleanings from the Minutes (1907–1928) (Presidential Address).

INSTITUTE OF METALS (Sheffield Local Section) (conjoint meeting in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—C. Johns: Influence of Pressure on Rocks and Metals (Sorby Lecture).

TUESDAY, OCTOBER 16.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Branch—Manchester and District) (at Milton Hall, Manchester), at 7.—A. Hindley: Pipe Sizing for Hot Water Supply Installations.

ROYAL AERONAUTICAL SOCIETY (Leeds Branch) (at Leeds).—Prof. S. Brodetsky: The Aerodynamics of Wing Sections.

WEDNESDAY, OCTOBER 17.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Science Museum, South Kensington), at 5.30.—W. H. Deakin: Early Days of Railway Signalling.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—J. E. Barnard and F. V. Welch: An Electrically Heated Warm Stage with Compressor for Use with High Power Objectives.—Prof. E. Ghosh: Two New Ciliates from Sewer Water.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Dr. M. Beddow Bayly: Voronoff and his Rejuvenation Experiments.

THURSDAY, OCTOBER 18.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. Sutton: Light Alloys and their Use in Aircraft.

INSTITUTE OF METALS (Birmingham Local Section) (in Engineers' Club, Birmingham), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Exhibition by Lantern of Colour Slides.

CHEMICAL SOCIETY, at 8.—Prof. T. M. Lowry, H. Moureu, and C. A. H. MacConkey: Studies of Dynamic Isomerism. Part XXVIII. Absorption Spectra of the Ketonic and Enolic Forms of an α-diketone.—W. A. Kirkby and Prof. R. V. Wheeler: Explosions in Closed Cylinders. Part I. Methane-air Explosions in a Long Cylinder. Part II. The Effect of Length of the Cylinder.—O. C. de C. Ellis and Prof. R. V. Wheeler: Explosions in Closed Cylinders. Part III. The Manner of Movement of Flame.—B. Flurscheim and E. L. Holmes: Pentanitroaniline.

BRITISH INSTITUTE OF RADIOLOGY, at 8.30.—Dr. L. A. Rowden: The Future of Medical Radiologists.—W. V. Mayneord: A Slide Rule for Radio Dosage Calculation.

INSTITUTION OF MINING AND METALLURGY (at Geological Society).

FRIDAY, OCTOBER 19.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.1), at 5.—Surg. Comdr. S. F. Dudley: Microbic Dissemination in Schools.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Problems in Human Anatomy which arise out of the Identification of a Skull attributed to Lord Darnley—Illustrated by Specimens.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—B. D. W. Luff: The Rubber Industry.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—R. W. Allen: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. H. Sharp: Technical Advertising.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne).

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—G. E. Holden: The Application of Paints to Textiles (Chairman's Address).

PUBLIC LECTURES.

SATURDAY, OCTOBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Animal Conquest of the Sea.

TUESDAY, OCTOBER 16.

GRESHAM COLLEGE (Basinghall Street), at 6.—A. R. Hinks: A Study of the Solar System. (Succeeding Lectures on Oct. 17, 18, and 19.)

WEDNESDAY, OCTOBER 17.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. Graham Little: The Health of the Medical Practitioner.

KING'S COLLEGE, at 5.30.—Sir Oliver Lodge: The Indebtedness of Industry to Pure Science: Introduction.

THURSDAY, OCTOBER 18.

UNIVERSITY COLLEGE, at 4.—Dr. D. H. Scott: Aspects of Fossil Botany. (Succeeding Lectures on Oct. 25, Nov. 1 and 8.)

SATURDAY, OCTOBER 20.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Sculpture in Ancient Egypt.

CONGRESSES.

OCTOBER 12–15.

ITALIAN CONGRESS OF INTERNAL MEDICINE (at Rome).—Prof. F. Schupfer, L. Dominici, and M. Gortan: Tumours of the Spinal Cord.—Prof. U. Gabbi: Undulant Fever and Bang's Bacillus.—Prof. L. Ferrannini and M. Ghiron: Diuresis and Diuretics.—Major G. D. D'Ambrosio: Functional Cardiac Disorders in Relation to Military Service.

OCTOBER 19.

HOUSING AND HEALTH (at Town Hall, Windsor), at 8.—Dr. W. Butler: The New House.—Miss Joan Sunderland: The Old House.

SATURDAY, OCTOBER 20, 1928.

CONTENTS.

State Control of Exploration.

THE spread of sovereignty to polar regions has resulted in various measures of authority in uninhabited or sparsely habited lands. These vary from the effective jurisdiction of Denmark in western Greenland and the police control of Arctic Canada to the merely nominal jurisdiction without resident authority in the British claims in the Ross and Falkland dependencies in the Antarctic. As the rule, the authority is exercised solely in the interests of the native fauna, and is aimed at restricting the destruction of game and at the same time levying some tribute on hunter and whaler.

The latest Arctic power is Norway, with her new-found possession of Spitsbergen, or to be more precise, the archipelago of Svalbord, an ancient name revived to embrace all the islands between lat. 74° and 81° N. from long. 10° to 35° E. Norwegian control of these islands was granted by the Supreme Council in 1920 and became operative in 1925. Norway's first act was the promulgation of game laws to restrict the ravages of the winter fur trappers; and now measures have been announced for the regulation of exploring expeditions that employ Norwegian vessels or engage Norwegian subjects in Norwegian ports. This will apply to most expeditions to Spitsbergen, since Norwegian subjects are nearly always included in their personnel, even if Norwegian vessels are not employed. Such expeditions in future must notify Norges Svalbard og Ishavs-undersökelser, the government department set up for the purpose. Their plans and equipment will be considered by a committee, which includes a government ship surveyor and a member with personal experience of Arctic wintering. This applies particularly to such expeditions as intend to winter or are proposing to go to regions where conditions may necessitate wintering.

The regulation is a wise one. It may rob the Arctic of many adventurous tales that the future might produce, since well-found and efficiently led expeditions do not produce the same measure of adventure or yield the same thrills as those in inexperienced hands; but we cannot regret that loss. Experience has shown that several expeditions in the recent past have been so poorly equipped or badly led, through lack of experience, that they have got into difficulties which necessitated relief measures either by the coal-mining companies in Spitsbergen or by the Norwegian State. The possibility of this burden and expense must be avoided in future so far as possible. On financial

grounds alone the new regulation of the Norwegian Government is justified. The sum expended on relief expeditions in Spitsbergen in recent years would have handsomely financed several useful polar expeditions. There is no reason to anticipate any interference with properly conducted expeditions or any desire to discourage legitimate enterprise.

Norwegian interest in her new possession does not stop there. The Spitsbergen department to which we have referred is organising, as indeed it has done for several years, the survey and scientific exploration of the country in so far as this work remains to be accomplished. It is now proposed, for the suggestion cannot be made obligatory, that all scientific expeditions to Spitsbergen should consult the Spitsbergen department before maturing their plans. By so doing, an expedition will save spending time on work that is already partly or wholly done or avoid overlapping the field of work of contemporary expeditions. Help of a more practical nature will also be available in reference to literature and maps and advice on routes and equipment. This information will be provided free of charge, and all that is asked in return is a report of the work of the expedition and copies of any publications concerned with its results. The institution of an inquiry office and bureau of advice has much to be said in its favour. There have been too many instances of overlap of work, and this applies not merely to Spitsbergen—especially when the results of expeditions have been long delayed in publication, and the difficulty of tracing the numerous papers, often in obscure journals of small circulation, is only too well known to all workers in polar regions. The Norwegian Spitsbergen department also promises the publication of research papers, at the cost of printing only, in its *Skrifter om Svalbard og Ishavet*. Anyone who has had occasion to work in Greenland and made use of the *Meddelelser om Grönland* must realise the value of the regional grouping of papers in this way.

Another aspect of Norwegian work in Spitsbergen deserves notice. The nomenclature of the islands is in a state of chaos. Many features have had several names, and many names have been corrupted and changed in usage. Some years ago Sir Martin Conway tried to unravel the muddle by going back to the earliest names for each feature. But historical precedence, though logical, is not always practical, especially in a land that is inhabited or much frequented. The Norwegian Government is now engaged in a survey of all Spitsbergen names with the view of reaching a state of finality. We understand that priority will be a general guide, but we trust that usage will not be overlooked. Familiarity may give a name justification; and it is to be hoped that the tendency which Norwegian maps of Spitsbergen have already shown of translating proper names of a descriptive nature will not be generally followed. Proper names, even if they are difficult of pronunciation by Norwegians, have at least historical value. It must be remembered that most place names in Arctic regions are labels that will be used only in scientific works and will not pass into popular use. There can, however, be no objection to the recommendation that new names proposed by any expedition should be submitted for approval to the Spitsbergen department. This measure is justified, and comparable steps are advisable in all polar lands. The Geographic Board of Canada is now engaged in a survey of all place names within the Dominion and has done much to dispel confusion. It is hoped that the Norwegian Spitsbergen department will be as successful.

Epistemology for Physicists.

An Account of the Principles of Measurement and Calculation. By Dr. Norman R. Campbell. Pp. x + 293. (London: Longmans, Green and Co., Ltd., 1928.) 12s. 6d. net.

THIS is a somewhat difficult book to review, and we are not quite certain that its title adequately describes its contents. In the first place, we may note that 'Calculation' seems here to denote a process quite different from the arithmetical investigations with which many of us are accustomed to associate the term. In his Chapter xii. Dr. Campbell gives the equations:

$$x = vt, \qquad y = \tfrac{1}{2}ft^2,$$

which he says can be established if a particle be projected horizontally in a gravitational field—although we fancy he might find it difficult to establish them except as conceptual limits, even if he could catch a 'particle' and project it horizontally. From these equations he deduces *algebraically*:

$$y = fx^2/(2v^2),$$

and terms the process 'calculation.' His chapter shows that he understands by calculation the deduction of mathematical results (by some form of algebraical analysis) from the equations, which are more or less approximately satisfied by the numerical values provided by physical experiment. The computer will meet only with disappointment if he hopes to find included under the "Principles

of Calculation" anything approaching a treatise, or even an essay, on the science of computing. No work on this topic exists in English, and the German text-books are by no means wholly satisfactory.

When, however, we have accepted Dr. Campbell's definition of 'calculation,' we see that his work is an epistemology of measurement and of the application of mathematical processes to the functional tables based on measurement, which appeals essentially to the physicist, and not to the computer. Although the reviewer has spent his whole life in measurement and calculation, he is very doubtful whether a careful study of the first 134 pages of the present work has at all cleared up for him his notions on the classification of magnitudes, on units and on factors. He has the misfortune to be English, and Dr. Campbell is Scottish, and therefore is probably a stronger logician. The great English physicists, in the reviewer's opinion, have in the past worked, perhaps, more by instinct than after a logical analysis of their fundamental conceptions. The inter-racial difference is well marked when our author comes—as he does at considerable length and with some degree of novelty—to deal with the "Principle of Similitude" as applied to the argument from dimensions. Here he writes: "All the difficulties and controversies of the subject have arisen from Rayleigh's tragic inability to give any clear account of a method of reasoning which he himself used with such great success" (p. 270).

The physicist who has reached 'instinctively' a solution even in Rayleigh's tragic fashion may test it and retest it experimentally without troubling himself greatly about the epistemology involved in his process. Nay, he may appeal, and justifiably appeal, to that famous proposition: "Qui veram habet ideam, simul scit se veram habere ideam, nec de rei veritate potest dubitare." Many great scientific discoverers have probably felt the truth of this without venturing to appeal to it, but it may not be a way of safety for the lesser workers. The only test of the relative virtues of the epistemological and 'instinctive' training—supposing, of course, a teacher of high order—would be for the latter to persuade half his pupils to study closely Dr. Campbell's first 130 pages and to tell the other moiety to proceed without doing so, and then to determine statistically their relative success in later experimental investigations.

Numerical dimensional problems have ever been a great stumbling-block to the student of slow receptivity at the start of his physical career; often far too little time and practice are devoted to them. Will Dr. Campbell's introduction to the general principles of measurement help such students? Only an experiment on a big scale can answer the question. We hope it may be made.

We have already referred to the topics of Chapters xii. (Calculation) and xiii. (Argument from Dimensions). Between these and the earlier eight, mostly classificatory chapters, are inserted three chapters on what are really statistical problems. A great deal of this seems to suggest that Dr. Campbell is not so fully acquainted with modern mathematical statistics as we might have anticipated. He is, we think, particularly unfortunate when he comes to deal with correlation in his chapter on 'approximate laws.' In the great majority of cases that the physicist has to handle, the bi-variate relation is not linear, and the student can learn little from the coefficient of correlation. He should be introduced straight away to the correlation ratio, which will be far more helpful to him.

Again, Dr. Campbell uses the term 'mean error' in the Gaussian or German sense: a use not established in England,[1] where the term 'standard deviation' is now fairly current. Although he rejects the normal curve of errors,—and rightly rejects it as a universal law,—his reasons for doing so (p. 182) seem to the present reviewer invalid. The 'fetish' character of this law can only and has only been demonstrated by showing that the astronomical errors and other distributions of deviations which are supposed to obey it, certainly do not, when a test of 'goodness of fit' is applied to these frequency distributions. Yet, although Dr. Campbell rejects the 'fetish,' he tells us on p. 169 that "the probable error is two-thirds of the mean error"! Again, at times he takes 'range' as a measure of the accuracy of his observations apparently in preference to standard deviation; but while the latter varies randomly with the sample, the former is a definite function of the number of observations, and the student must carefully bear this in mind. When Dr. Campbell lays such stress on terminological exactitude, we read his pp. 192-3 with some surprise. Taking two variates x and y, using a bar to denote mean quantities, and the symbols ξ and η to be given by $\xi = x - \bar{x}$, $\eta = y - y$, we have the definition of the coefficient of correlation $r = \overline{\xi\eta}/\sqrt{\overline{\xi^2}\,\overline{\eta^2}}$. He

[1] In English writings 'mean error' means what it says, the mean arithmetical error, regardless of sign.

now supposes all the observations to be repeated and denoted by x' and y'. He then takes:

$$E_x^2 = \tfrac{1}{2}\,\overline{(x - x')^2}, \qquad E_y^2 = \tfrac{1}{2}\,\overline{(y - y')^2}$$

as the mean errors of x and y. It is not easy to see why E_x and E_y are really the 'mean errors.' The mean error for any given value of x cannot be found from *two* observations at that point. Does Dr. Campbell suppose the observational error to be the same throughout the range of x? If it be not—and the present reviewer's experience is not in favour of the constancy of error at all points of a physical range—then what is the true physical meaning of E_x and E_y?

Dr. Campbell now writes:

$$Y_1^2 = \bar{\eta}^2$$
$$Y_2^2 = \bar{\eta}^2(1 - r^2)$$
$$Y_3^2 = E_y^2 + b^2 E_x^2$$
$$\text{and } b^2 = r^2\bar{\eta}^2/\xi^2$$

and says:

"Of these, Y_1 measures the *total range* over which y varies; Y_2 the *part of this range* which cannot be attributed to variation of x: Y_3 that which can be attributed to errors of measurement." The italics are the reviewer's. What will the student make of the statement that the standard deviation of y, which includes the observational errors of y, is the *total range* over which y varies? What will he understand when he is told the square root mean square distance of individual y's from a certain straight line—a line determined by the Gaussian process—is a *part of this range*? Lastly, how has Dr. Campbell demonstrated that Y_3 is 'that' (presumably 'part of total range') which can be attributed to errors of measurement? Presumably, in obtaining it, he has neglected quantities to which he does not refer. Why b and not b', and why has he assumed that the points x, y, x', y' really lie on a straight line, and that that straight line is the one determined by the Gaussian 'fetish'?

These difficulties are well illustrated on p. 200, where Dr. Campbell applies his formulæ to a special example, and assumes that since r is as big as $+0{\cdot}962$, it suffices to prove perfect correlation that Y_2 and Y_3 are nearly equal. But neither Y_2 nor Y_3 is a measure of the variability of r due to random sampling, and the 'mean error' of r—to which he does not here refer—would not be even for 200 observations—that provided from the Gaussian 'fetish' formula on his p. 192.

One further citation from these statistical pages:

"There always is a limit beyond which increase of number does not improve consistency on repetition. Where the limit lies can be determined in any particular case by subdividing a set of observations; if the result obtained from each of the two values does not differ appreciably from that obtained from the whole, then the number is sufficient. But what is meant by 'appreciable'? An inappreciable difference is one not greater than that due to the step in the measuring instrument, for differences of this order can never be eliminated; but again it may be a counsel of perfection (sometimes even of impossibility) to prescribe that such consistency is always to be attained."

This appears to us entirely erroneous and we believe Dr. Campbell will see that it is so, if he will first measure five hundred lengths with a scale with fine micrometer attachment, and then crudely classify his lengths into groups corresponding to, say, centimetres. He will find that the mean of the latter is much nearer to the mean of the micrometer readings than is due to the centimetre step of the crude readings, and the source of this agreement is fairly obvious. A mean is, indeed, far more accurate than the step in the measuring instrument, although we have heard distinguished astronomers ask why the mean is given to two decimal places, while the scale only admits of reading to the first decimal.

We are not writing with any desire of captious criticism. We hope, and believe, that a second edition of this book may be called for; and should this be so, perhaps Dr. Campbell may be willing to rewrite this statistical portion of his work with the epistemological exactitude he demands in more purely physical conceptions. At least let us have a statement of the limitations the formulæ he provides involve.

Home-grown Sugar.

Sugar Beet and Beet Sugar. By R. N. Dowling. Pp. x + 277 + 24 plates. (London: Ernest Benn, Ltd., 1928.) 15*s.* net.

DURING the War it was realised in Great Britain that there can be great danger in complete dependence upon imported food supplies. When, therefore, the crisis of the enemy submarine campaign was over, increased consideration was given to British agriculture, and the possibilities for home food production. The position of the farmer with regard to the rest of the nation was seen to be one of the greatest importance, and in many schemes of reconstruction emphasis was laid upon the national requirement of a large area of land to be maintained in a highly productive condition. With the passing of the years, however, memories

of crises have become blunted, and there is now a tendency to revert to what seems to be the normal view of agriculture and home food production. The farmer appears once more as an individual whose production and trading must depend for success upon the chances of markets which are open to the goods of the whole world, and not upon a point of national necessity. The value of home produce is measured by the usual standard of free markets, and the great weight of the fear of hunger in a time of war diminishes in the balances of opinion.

Despite this tendency, we have still with us considerable survivals of the War period in the form of regulations, committees, and increased facilities for agricultural research; and it is fair to regard the sugar beet subsidy and the increased acreage under that crop as one of the results of the War and of the trend of thought arising from it. The subsidy, which is a decreasing one, came into operation in the season 1924–25. It has now run through its first four years, and has come to the point where it drops from 19*s*. 6*d*. per cwt. on home produced sugar to 13*s*. per cwt. In another three years it should drop again to 6*s*. 6*d*. per cwt., and then disappear altogether.

The subsidy was intended to act as a shield to a young and growing industry during its early and critical years, and it has coincided in the first stage with a very remarkable increase in the acreage under sugar beet and in the number of factories employed in the extraction and manufacture of the sugar. In 1924 there were 23,700 acres under the crop and 3 factories; in 1925, 51,140 acres and 9 factories; in 1926, 125,000 acres and 14 factories; and in 1927, 222,000 acres and several more factories. The rotations of a good deal of arable land in England have been modified to include this crop, which produces both cash and a considerable amount of food for stock, and there is a large number of growers who have found great benefit from the crop in the farm crisis of the past few years.

We have come now to the first real testing point of the subsidy scheme, and the next three years will show what part of this great increase of interest and acreage is to become a permanent feature of agriculture in England and what part is merely the effervescence of a boom period. It has been known for a great many years that high quality sugar beet can be grown in England with the ordinary technique used in various districts for mangolds and potatoes, and the experiments of Duncan in Suffolk in 1860, and of Lawes at Rothamsted some few years later, were easily confirmed by the Board of Agriculture trials at seven centres in 1911. The main question has always been one of economic expediency and not of cultural possibility, but despite this there is no doubt that the progress of sugar growing in England in future will depend on the technical ability of our farmers in growing and handling the crop and its by-products.

As the economic shelter of the subsidy disappears, the English grower will come into direct competition with the foreign and colonial growers, and his skill will be tested in direct comparison with theirs, and in the beginning of this comparison it is disconcerting to note how low have been our average yields of beets during the past several years. The lowest figure appears in 1923, when about 17,000 acres averaged only 4 tons per acre of washed beets, and the highest in 1926, when with a favourable season 8·7 tons per acre were recorded on 125,000 acres. The average for the eleven years 1912–15 and 1920–26 was 6·16 tons per acre.

Even when the vagaries of season and the inevitable mistakes of growers in the production of a new type of crop have been allowed for, this average appears to be disappointing and compares very unfavourably with the crops obtained in some of the competing countries and by some successful growers in England. Under really favourable conditions, crops up to 20 tons per acre have been obtained in England, while there are very many places where farmers have grown and sold 12-14 tons per acre on large areas of land. It seems that in the growing of this crop the farmer has a very well-marked opportunity for the exercise of technical skill, and the difference between a 12-ton crop and the average of 6 tons must be accounted for in most seasons by the difference in the degrees of skill and judgment found in the growers.

Of course, the ultimate measure of a sugar beet crop must be taken in terms of sugar per acre, and therefore the sugar content of the roots comes to have considerable importance. Of late years the average sugar content in England has been as good as that of the continental crops, and it appears that we have not so much room for improvement in this particular as in the matter of yield of beets to the acre. It is not too much to say that, unless the average crop can be raised from 6·16 tons per acre to 9 or 10 tons per acre, there will be no future for sugar beet growing as a large branch of British agriculture.

Mr. Dowling's book, following upon a smaller work on the same subject, is the first attempt to deal comprehensively with the crop as it appears in England. It is in the nature of a text-book, and is a painstaking piece of work which gives the

general principles for the successful culture of sugar beet in a form which is easily available to both farmers and their many advisers. It has also the advantage of appearing at a time when it can be really useful.

There are considerable opportunities for agricultural scientists of various kinds to extend and improve the information which exists at present in such matters as the special manuring of sugar beet; the breeding of strains suitable to varying conditions of soil and climate; and the design and use of labour-saving machinery, but the immediate problem lies with the growers. The soil, climate, and knowledge already available are good enough to raise the poor yield of the average crop by several tons per acre, if they are only used to the best advantage. Unless this is done in the next three years, we cannot hope to find a strong and important sugar beet industry as a feature of British agriculture at the end of the subsidy period.

CLEMENT HEIGHAM.

Theoretical Physics.

(1) *Handbuch der Physik*. Herausgegeben von H. Geiger und Karl Scheel. Band 5: *Grundlagen der Mechanik, Mechanik der Punkte und starren Körper*. Pp. xiv + 623. 51·60 gold marks. Band 7: *Mechanik der flüssigen und gasförmigen Körper*. Redigiert von R. Grammel. Pp. xi + 413. 34·50 gold marks. (Berlin: Julius Springer, 1927.)

(2) *Lectures on Theoretical Physics delivered at the University of Leiden*. By H. A. Lorentz. Authorised translation by Dr. L. Silberstein and A. P. H. Trivelli. Vol. 2: *Thermodynamics*, edited by T. C. Clay-Jolles; *Entropy and Probability*, edited by Dr. C. A. Crommelin; *The Theory of Radiation*, edited by Dr. A. D. Fokker; *The Theory of Quanta*, edited by Dr. G. L. de Haas-Lorentz. Pp. xii + 410. (London: Macmillan and Co., Ltd., 1927.) 21*s*. net.

(1) THE two volumes before us of Geiger and Scheel's "Handbuch der Physik" contain a complete survey of those portions of the mathematical analysis of the mechanical principles and their applications which have any bearing on physical phenomena and theory in the broadest sense of those terms. After a preliminary short section on the various axiomatic systems of mechanics, the first volume opens with an excellent analysis of all the fundamental principles and methods employed in the attack on the soluble problems of dynamics. This is followed by a short section on the important subject of disturbed motions, the first step towards the solution of more general problems. These two sections on general principles and methods are followed by a number of chapters on the detailed application of the methods to specific problems: the first of these is on the kinematics of a point and rigid body; then there is a chapter on the geometry of forces—including the graphical methods, and one with the usual treatment of the dynamics of mass point systems and of rigid bodies. This volume concludes with a section on the applications of dynamical principles to technical problems, and a final short section on the bearing of the special and general relativity theories on the principles and results of the previous general theories.

The second and smaller volume treats of the mechanics of fluid media. It commences with a section on the formal theory of ideal fluids and the usual problems which are dealt with in that theory; the second section contains the usual and familiar theoretical treatment of viscous fluids. The third and fourth sections deal with the various points of interest which arise in the technical applications of the subject in hydraulics, to such problems as water flow and propeller motions. The fifth section treats of the dynamics of gases—including a discussion of finite streaming—and the book is completed by a long and comprehensive section on capillarity.

In both volumes, but perhaps—from an English point of view—more particularly in the second, the details of the treatment of the separate subjects are on familiar lines, but the choice and arrangement of the matter represents a definite and carefully planned compromise between the intensely mathematical treatment of the larger treatises and the purely descriptive physical ones of the text-books. But it is this careful balance which is everywhere maintained between the mathematical analyses of the subject and the purely descriptive expression of the underlying physical principles and results, which is the most pleasing feature of the whole work, and will therefore commend these volumes to those who are attempting to obtain a sane outlook on these subjects in particular and physics in general—a somewhat difficult matter in these days of wave mechanics and matrices.

In England theoretical physics, or 'applied mathematics,' as some of us like to call it, has unfortunately fallen between two stools—or 'chairs' in our university meaning of that word. On one hand, we have the mathematician, doing it as applied mathematics, that is, as a set of axioms

on which changes can be rung with the instruments of pure mathematics, who has less interest in maintaining a vital contact between the subject and the real facts of life than in obtaining an exact solution of a difficult and artificial problem. On the other hand, we have the experimental physicist with little or no mathematical training and a tremendously suspicious attitude towards anything involving a double integral or the *curl* of a vector, who does not realise, therefore, that the most general mathematical expression of a physical result is probably the most definite, concise, elegant, and illuminating expression of that result that it is possible to obtain

This unfortunate state of affairs will continue so long as we refuse to recognise that theoretical physics and applied mathematics are really one and the same subjects, and that if it is necessary for the mathematician to do theoretical physics to maintain his mental equilibrium—as many of us feel—it is even more necessary for the physicist to do applied mathematics to enable him to appreciate the full meaning and bearing of his experimental work; but it is some such compromise between our present views of these two subjects as is offered in these two books that should really be taken by both sets of students.

However, this purely domestic matter has little to do with the two books before us, except that it induces us to commend them to our physicists and mathematicians more strongly than might otherwise be necessary. Apart from this, the two volumes are worthy models of what a 'handbook' really should be, and we may congratulate the authors in particular, and the editors and publishers in general, on the really successful achievement of this part of their plan.

(2) The second volume of Lorentz's lectures is in four sections, dealing separately and respectively with thermodynamics, entropy and probability, the theory of radiation, and the theory of quanta. The first section, on thermodynamics, covers all the usual topics of the text-books on this subject, including the applications to phase theory and the graphical geometrical treatment of the problems that arise therein. The second section, on entropy and probability, commences with Boltzmann's deduction of Maxwell's law, and then discusses Gibbs's method of canonical and micro-canonical assemblages and the statistical definitions of entropy. The third section contains one of the few consistent treatments in existence of the fundamental laws of the theory of radiation, finishing up with Jeans's and Planck's derivations of the fundamental function. The last section, on the theory of quanta, gives in broad outline Bohr's theory of atomic structure with its modifications by Debye, Epstein, Sommerfeld, and others, and also the main applications of the same ideas to the theory of the material states.

This second volume differs somewhat in character from the first volume, in that it deals in a rather less specialised manner with the subjects covered in the titles. The separate sections of the present book are in fact more in the nature of introductions to their respective subjects; and presented as they are with the generality and all the ease and grace of Lorentz's inimitable style, they combine into a really excellent text-book, admirably suited for use by students commencing a theoretical study of these subjects. Each section contains all the essential theoretical and practical details of the topics it handles and is as complete as possible in the limited space allotted to it.

The translation is unfortunately not quite up to the standard of the previous volume. The desire to be literal has resulted too frequently in clumsy sentences in unusual grammatical form, which could easily have been recast in a clearer and more elegant form; and occasionally the sense has disappeared entirely from the text. For example, the phrase "the whole can be attributed a definite free energy," which occurs on p. 51, and the italicised phrase on p. 157, namely, "the results of a lottery can acquaint us with the real state of a system," do not convey much to a reader unfamiliar with foreign grammatical form. These blemishes, however, although frequent, are not serious enough to prevent the reader from getting the full sense of the text very easily, and they do not therefore materially detract from the general excellence and usefulness of the book.

G. H. L.

A Record of Physiology in Great Britain.

The Journal of Physiology. Author Index to Volumes 1 to 60. Issued by the Physiological Society and published as a Supplement to *The Journal of Physiology*, June 1928. Pp. ii + 235. (London: Cambridge University Press, 1928.) 25*s*. net.

THE pre-eminent position of British physiology is inseparably connected with the *Journal of Physiology*, which was established in 1878 by the late Sir Michael Foster and A. G. Dew-Smith two years after the Physiological Society was started on the initiation of Sir J. Burdon Sanderson.

The interesting "History of the Physiological Society" during its first fifty years (1876–1926), written by Sir Edward Sharpey-Schafer, was brought out as a supplement to the *Journal* last December (*vide* review, NATURE, Mar. 31, p. 491), and now an author index to volumes 1 to 60 of the *Journal* (1878–1928) has been issued as a supplement to its June number. These two supplements have appropriately appeared close together, for they cover practically the same—the Augustan—period of British physiology, during almost the whole of which the *Journal* was under the editorship of the two Cambridge professors, Michael Foster and J. N. Langley.

Turning over the pages of this important record, the reader finds that though no one has contributed to every volume of the *Journal*, the late Prof. Langley's name appears in all but six, being absent from vols. 21, 26, 32, 34, 44, and 55; that Sir Edward Sharpey-Schafer had papers in vols. 3 and 60, with many in between, and that Sir Charles Sherrington's name first appears in vol. 5 and steadily continues to nearly the end. A distinction is made between papers in the *Journal* and communications in the *Proceedings of the Physiological Society*, which first appeared in vol. 4 of the *Journal*; thus among the 128 entries under the late Prof. Langley's name there are no less than 82 papers in the *Journal*, the remaining 46 being in the *Proceedings* of the Society. His successor in the Cambridge chair of physiology, Prof. Joseph Barcroft, makes his first appearance in vol. 25 (in 1900), and so far has made 63 contributions, of which 36 are papers in the *Journal* and 27 communications to the Physiological Society.

A noticeable feature is the large number of combined papers; thus there are thirteen by Profs. Starling and Bayliss. There is also much evidence of the stimulating influence of the senior on the junior worker in combined authorship; this is shown, for example, in 49 out of the 63 entries under Prof. Barcroft's name, in 35 out of Dr. J. S. Haldane's 48, in 41 out of the 128 entries under Prof. Langley's name, in 19 out of Sir E. Sharpey-Schafer's list of 35, and in 20 out of the 45 standing to the credit of the late Dr. Sidney Ringer, a most constant contributor to the first eighteen volumes.

This author index is a most interesting record, an extremely useful source of reference, and a monument, if it were needed, to the work of British physiologists.

H. R.

Our Bookshelf.

What Botany really Means: Twelve Plain Chapters on the Modern Study of Plants. By Prof. James Small. Pp. 200. (London: George Allen and Unwin, Ltd., 1928.) 5*s.* net.

A GLANCE at the illustration at the beginning of this book, which illustrates the adventures of running sap, is sufficient to show that the book is constructed on unusual lines. Upon critical examination, probably any regular reader of NATURE could find some section which might undergo alteration in the interest of accuracy. At the same time, most readers would regretfully disclaim the capacity to produce such a book, and the vast majority would agree with the reviewer that its production is a definite gain to botany as well as to the community.

The text has evolved out of a series of broadcast talks from the Belfast station of the British Broadcasting Corporation, and something of the vividness and spontaneity of the original spoken phrase adheres to this slightly more formal presentation of the subject matter. In trans-Atlantic phraseology, Prof. Small seems to possess the rare faculty of "getting his ideas across" to a general audience of all ages. For one thing, he sees the romance behind the routine task of the grower, the manipulator and the vendor of plants. His book may be recommended very warmly to the general reader. It reminds the average man to what extent his life is based on the growth and activity of the plant, and at the same time it reveals very interesting glimpses of the fascinating and fundamental problems that arise as soon as his interest is aroused in them. The comparison of the plant with an internal combustion engine is particularly well worked out.

Prof. Small claims that only three technical terms are employed in his twelve chapters, enzymes, osmosis, and gametes. The language is certainly very simple and non-technical, in view of the fact that fundamental problems in plant physiology are squarely faced. Diffusion, if regarded as technical, would have been a welcome additional term. It might have avoided the implication on p. 92 that the sugar solution draws not water merely, but salt also, into the osmotic cell.

Electric Rectifiers and Valves. By Prof. Dr. A. Güntherschulze. Translated and revised by Norman A. de Bruyne. Pp. ix + 212 + 10 plates. (London: Chapman and Hall, Ltd., 1927.) 15*s.* net.

ELECTRIC valves have been rapidly coming to the front during recent years for many and varied purposes. For example, the building of large alternating current power stations to replace direct current stations scattered over a wide area has raised the problem of whether it is possible to utilise the old machinery. The invention of the mercury arc rectifier has in several cases prevented the old machines being scrapped. For broadcasting use there has been a great demand for small rectifiers. Valves are also used to produce high frequency

oscillations, to act as cut-outs so as to prevent reverse currents, to measure small alternating currents, and for many other purposes.

The method of producing direct current by rotary converters entails having an attendant to look after the rotating machinery. Electric valves need very little attention. There are many different types of rectifier in use, each involving a different physical process. The best known are the mercury arc, thermionic valve, electrolytic valve, those that produce discharges through gases, and contact rectifiers.

The book under notice is divided into two parts. The first part gives a good account of the physical theory of the action of valves. The second part describes the various kinds of devices used in commerce. The arc valve is the most important in practice, and large mercury arc rectifiers with outputs measured in thousands of amperes are in everyday use. The author gives a very brief account of the mercury jet rectifier invented by Prof. Hartmann. This mechanical device is now well known. An interesting and novel use for valves is for producing electric waves of any desired shape. The method is fully described. This book will be specially useful to research physicists.

The Cable and Wireless Communications of the World: a Survey of Present Day Means of International Communication by Cable and Wireless; containing Chapters on Cable and Wireless Finance. By F. J. Brown. Pp. ix + 148. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 7*s*. 6*d*. net.

THIS book appears at a timely moment, as the question of the future of international communication is one that must soon be settled. Great Britain has always taken the lead in submarine communication. It still possesses nearly half the total mileage of submarine cables in the world. The price of cabling to New York was originally £20 per message consisting of 20 words and one pound for each additional word averaging five letters. It is now ninepence a word. This can be greatly reduced by the use of codes or by sending deferred messages. Letter telegrams are also coming into use, the communication being sent by post to the sending end of the submarine cable and being sent by post from the receiving end. In the beam radio service between Britain and Canada a post-radio-letter telegram system is used at a charge of 1½*d*. per word. We see no reason to doubt that the prices will be still further reduced.

Notwithstanding the remarkable rate at which radio communication has developed, submarine cables still remain the principal means of telegraphic intercourse between the widely separated countries of the world. The author of the book under notice investigates the inherent costs of radio and cable systems; but it is difficult to arrive at definite conclusions, as the radio public companies do not separate the financial results of their communication services from their manufacturing activities. The desirability of having State or private ownership of long-distance telegraphy and telephony is also discussed. Many interesting data are given, and the book can be commended to all interested in long-distance communication.

Cain; or, The Future of Crime. By George Godwin. (To-day and To-morrow Series.) Pp. 108. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2*s*. 6*d*. net.

A VERY strong plea for the humanitarian and scientific treatment of the criminal. At the same time, the author's wholesale rejection of the death sentence for murder is a matter for considerable argument. He thinks that the deterrent effect of hanging is of small moment. Let him visit a few of the London bars and study the occupants, and say if fear does not keep some of them from taking the lives of their fellow-creatures. Why do racecourse gangs work in gangs? For one reason—because of the individual's fear of punishment and hope of avoiding it in the crowd. There is, however, much very good sense in the book, and the author's plea for the delinquent child is sound and his peep into the future of crime not far off what will be truth.

The Phase Rule and its Applications. By Prof. Alexander Findlay. (Text-books of Physical Chemistry.) Sixth edition, revised and largely rewritten. Pp. xv + 326. (London: Longmans, Green and Co., Ltd., 1927.) 10*s*. 6*d*. net.

FINDLAY'S "Phase Rule" is too well known to call for a lengthy review on the appearance of a new edition. It is now five years since the *format* was changed in a new post-War edition of the book, and the subject is too well established to require a similar drastic revision at the present stage. The present edition is, however, 28 pages longer than its predecessor, and includes a new chapter on the practical application of equilibrium diagrams, in addition to the modifications and additions that have been made elsewhere. The revision has therefore been sufficiently thorough to ensure that the book shall be kept up-to-date, and the purchaser of the sixth edition need have no fear that he is securing a mere reprint of a former issue.

Outlines of Scientific Anatomy: for Students of Biology and Medicine; designed to Supplement the usual Text-book Teaching. By Prof. Dr. Wilhelm Lubosch. Translated from the German by Prof. H. H. Woollard. Pp. xiii + 392. (London: John Bale, Sons and Danielsson, Ltd., 1928.) 21*s*. net.

IN this book Prof. Lubosch attempts to deal with the facts of anatomy in such a way as to bring them into the widest possible correlation with learning in general. Or perhaps it would be more correct to describe his essay as the creation of a system of philosophy based upon speculations concerning the structure and developmental history of the human body. To many biologists such a mode of approach to the study of living creatures may seem far too transcendental to be of serious value; but the philosophically-minded student may discover a new interest in the dry bones of anatomy by indulging in such day-dreaming as Prof. Lubosch's fantasies provoke.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Evidence of Survival of a Human Personality.

I HAVE just been able to see NATURE of Aug. 18 before leaving America for Australia, and must ask permission to reply to the editorial article in that issue referring to my report, which, as you were good enough to admit, established at least a *prima facie* case for the supernormality of the Margery phenomena.

The article referred to is fair but weak. The supernormal does not mean the supernatural. Everything must be accordant with Nature when properly understood, but for lack of experience some things that occur may seem to us strange and exceptional. That is no reason for refusing scientific attention to them when reasonably evidenced. A century ago, the breaking down of a chemical element would have been regarded as supernormal—there is no need to multiply instances of things which would have been discarded at one time, though as knowledge grew they were accepted and incorporated into the body of organised science.

The purport of my article is to show men of science that supernormal phenomena *do actually occur* in Nature and ought therefore to be studied by them. I cannot accept the plea that science has too much to do to attend to them: such an attitude would have excluded many now recognised discoveries. The discovery of radium ultimately broke up the old physics and opened up a new atomic theory. Biology will never progress so long as it is built on the foundation of the material cell and molecule and atom: psychical phenomena clearly point the way to a deeper understanding of the meaning of life. My call is not to the older biologists but to the younger men, feeling confident that some of them have the courage and vision to follow up the new path into unexplored territory.

On page 230 complaint is made of the "inadequacy and oddity of the tests." The tests were not inadequate, though they may appear so after the rigorous pruning and shortening of my report on which you insisted; and it is not their oddity which should surprise you, but the evenness of the results.

On page 230, par. 4, the phrase "my number" only signified that it was the number selected by Walter out of my lot of sheets. A reader could see that that was all I intended to convey.

You also ask in the same paragraph whether we signed "all the sheets under instruction." The answer is No. Other misapprehensions would have been removed by my full report. I had made secret signs on some of them, and otherwise had taken every precaution *to prevent fraudulent substitutes of my sheets, but these details had to be cut out for brevity in the version you admitted.* The object of the test was to see whether Walter could select and cognise numbers in the dark and then convey those numbers mentally to Mrs. Litzelmann, eighty miles away. Even assuming that Margery was awake and could see in the dark, you have not even begun to offer an explanation of how Mrs. Litzelmann simultaneously wrote those numbers, eighty miles away, in a tiny village without any quick means of communication with Boston. As to what the writer of the article thinks may have been Mrs. Litzelmann's successful 'shot' at a square and a circle, it must be remembered that she did not even know that it was to be a drawing test, and that Mr. Evans might have drawn anything—flowers, fruit, animals, anything; so it is unreasonable to attribute success to mere chance.

As a further test of Walter's power to see and do things in the dark, I may mention that, at a subsequent sitting on Aug. 9, Dr. F. Muir, of Honolulu, was with me, having brought some pieces cut out of a magazine to see if Walter could decipher them and pass a knowledge of them to Mrs. Litzelmann sitting simultaneously in her own home in Cambridge. Two of these fragments he took out of his pocket and gave to Walter in the dark. After the séance, Margery wrote the words "The Moon" and "No Joke"; and these words were afterwards found to correspond with the slips presented at random. I took a telephone call to Mrs. Litzelmann's house, and they reported that she had drawn a crescent moon followed by some hieroglyphics (see Fig. 1), which when held to a mirror reads as the word "joke."

FIG. 1.—Copy of what Mrs. Litzelmann wrote at a distance of 80 miles from the séance of Aug. 9.

At the same sitting Walter chose the numbers 4, 1, and 14 from a calendar, and said that he would make Mrs. L. write it backwards. She wrote 41. I ask you what normal reason could she have had for writing this rather than any other combination of two digits. The suggestion that this lady, sitting simultaneously, miles away from the Crandons, can be an accomplice of theirs in fraud is really too wild to be taken seriously.

With regard to thumb-prints, the writer of the leading article in NATURE says that few of us could draw the pattern of our thumb-prints even while we have our thumbs. Exactly, that is what makes the thumb-print test so cogent as an individual character. He implies that it can have nothing to do with survival; but some psychical researchers, including myself, hold *as a possibility* that a surviving personality might possess a psychic body or soul, having a psycho-physical parallelism with the physical body which is dead. If we can prove this, we also prove at the same time that *living men* are not mere physical bodies only, but psychic bodies (spirits, if you like) clothed temporarily in physical bodies, just as our physical bodies are covered with clothes. The problem is a greater one than that of mere survival; it concerns the basic nature of our existence *here and now*, as well as *hereafter*. Now it is an indubitable fact that Walter, dead for sixteen years, does give a consistent thumb-print in wax, which is not that of the medium or any of the sitters. He claims that it is his own thumb-print. The print agrees exactly with that afterwards *found on the razor used by Walter on the morning of his death, though the latter shows only a portion of the ulnar area. Either, then, these prints are really those of Walter's psychic thumb, or they are produced fraudulently. It is my business as a researcher to eliminate all possibilities of fraud, so as to present this tremendous truth with irresistible force to the scientific world.*

Finally, on my return to America, in order to eliminate every chance of collusion unless I myself were the culprit, Dr. Crandon allowed me to have a sitting alone with Margery; he and my assistant being outside the door. Under these conditions Walter came through, talked while Margery's mouth was prevented from speaking by Dr. Richardson's

'voice machine,' and finally gave me three excellent thumb-prints. Margery was bound hand and foot by adhesive medical tape, and otherwise fully controlled, her feet being in shoes and stockings.

This 'solus' sitting is unanswerable. It is the crown and triumph of my work in psychical research. It now only remains for sceptics to accept the proof or to attack my own competence and veracity.

R. J. TILLYARD.

San Francisco, Cal., U.S.A.,
Sept. 4.

[WHEN on his way to New Zealand, Dr. Tillyard sent a long letter in reply to the leading article in NATURE of Aug. 18. Space could not, however, be found to publish the letter in full, and as much delay would be involved if it had to be sent to him for abridgment, we decided to ask a friend who is an expert in the subject to condense it and yet include the salient points. The letter represents this abbreviated version of the original communication.

We cannot think that in his letter Dr. Tillyard has added any cogency to his article. He does not attempt to reply to the very pertinent remarks we tentatively made, and above all to the suggestion that the experiments were not devised by himself. Moreover, his attempt to show that he had tried to prevent substitution of the calendar sheets by making secret signs is entirely beside the mark. No substitution whatever was necessary. Dr. Tillyard provided the critic with a normal explanation by using *all* the calendar sheets and then handing over the whole packet when told to do so by the 'Control,' as also did Mr. Evans by drawing *ten* diagrams when *one* playing card drawn haphazard from his own pack would have been sufficient. Instead of explaining why he did those things, he speaks of new experiments at subsequent sittings, both alone and with others, on which we do not propose to comment.

Before these alleged 'psychic' phenomena can be accepted by the scientific world, the method by which experiments are conducted will have to be wholly revised. The novel atmosphere of the séance room and the unexpected events which take place there are often apt to blind the newcomer to the faulty scientific procedure that prevails. The observers are never really the experimenters. They are the obedient servants of the 'Controls,' who direct their actions, their tests, and their general behaviour. If they attempt to assert their authority, either their presence is considered undesirable, or the 'phenomena' cease. The conclusions of the Sorbonne Commission a few years ago that 'psychic' phenomena tend to decrease in proportion as control conditions are applied, admit of few if any exceptions; and until Dr. Tillyard's results are independently confirmed under much more rigid conditions, and without the flaws indicated above, it would be rash to suppose that this case provides better evidence for the supernormal than those hitherto reported.—EDITOR, NATURE.]

Capillary Properties of Moist Granular Media.

THE following experiment may be of interest as providing a very simple and direct means of demonstrating the behaviour of a granular medium in regard to capillary properties and the Osborne Reynolds effect. An excellent material for the purpose is the tinsel known as 'glistening dew,' which consists of minute spherical beads of glass of considerable uniformity.

A U-tube arrangement is set up with one arm formed by a burette with double-bored stop-cock, while the other arm terminates in a Buchner funnel containing the glistening dew or other medium. The apparatus is filled with water so that the glistening dew in the funnel is flooded. Then by simple manipulation of the burette stop-cock the water level can be lowered in stages and the water in the voids of the glistening dew subjected to a pressure deficiency increasing at each stage. The water drawn out of the medium can be observed on the burette scale at each stage. In a particular case the mean particle radius was $r = 0{\cdot}019$ cm. and the material showed a pore-space of about 36 per cent of the total volume. If the pressure deficiency is expressed in terms of T/r (T = surface tension of liquid), this allows of direct comparison between cases in which different materials and liquids are used. The following points can be observed:

(1) The first stage, which covers suction values from zero to about $3T/r$, is marked by a tightening of the water film round the surface layer of particles. The surface appearance changes from shiny to matt in consequence. The material remains saturated, the amount of water yielded by this surface change being very small.

(2) Over this same range the Osborne Reynolds effect may be demonstrated (namely, the anomalous dilatation of a granular medium under compression). If the surface of the glistening dew is loaded an expansion takes place causing an increase in the volume of voids. The conditions allow the material to remain saturated so that water is drawn out of the burette with a slight increase in suction value. On removing the load, recovery takes place, the excess water released causing a momentary glistening of the surface.

It may also be observed that the change of the water film from the relaxed to a tensed condition over this range causes a very marked increase in rigidity in the material, the increased stress between the particles increasing the internal friction.

All the above phenomena are familiar in the behaviour of sea-shore sand drained by a receding tide and compressed by the foot. Under suitable conditions the regional increase in suction due to compression and dilatation may be considerable.

(3) As the suction rises above the value $3T/r$, the water film begins to enter the material at the points of least resistance, *i.e.* at the largest surface pores. The character of the pore space is that of a number of cavities communicating by comparatively narrow passages. Hence the entry of the film into a cavity is sudden, an expansion of the film taking place as soon as it has passed the narrowest point of the entry passage. In other words, the atmosphere 'blows a bubble' into the cavity. This entry of air causes an increase in internal reflection of the neighbouring particles, so that the process is evidenced visually by sudden scintillations of the surface particles. It may be watched in detail with the aid of small magnification.

(4) The entry of air in the above manner does not become general until the pressure deficiency reaches the region of $6T/r$, which may be regarded as the average 'entry value.' This is evidenced by the fact that less than 1 per cent of the moisture in the glistening dew is lost up to this point and that about 70 per cent drains out with but a slight increase in the pressure deficiency. The material now becomes white and glistening—a change which corresponds to the lightening of colour when any wet granular medium dries.

(5) When the water is allowed to flow back by reducing the suction to zero again, bubbles of air are retained in the pores to the extent of about 19 per

cent of the total space. The tendency is always for narrower places to fill first with water, which has the effect of trapping bubbles in the larger cavities. These bubbles may be made to rise to the surface by jarring the flooded material. The increments of moisture take place at lower values of pressure deficiency than those for decreasing moisture, so that the suction-moisture curve when plotted passes round a hysteresis loop.

A fuller treatment of the subject, particularly in relation to soil studies, has been given in the *Journal of Agricultural Science* (**17**, p. 264; 1927).

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Theory of Electrical Migration of Ions.

THE object of this note is to show that the theory of moving boundaries as developed by Kohlrausch and Weber overlooks the unequal transfer of the common ion at the boundary and consequently rests on a misconception of the conditions on the 'indicator' side of the boundary. For a stable boundary it is necessary that the slower moving ion follows the faster moving one and both should move at the same speed. This happens when the concentrations of the two electrolytes AR and BR on the two sides of the boundary are related as in the equation (1) $\alpha/n_A = \beta/n_B$, where α and β are respectively the concentrations of the electrolytes AR and BR, and n_A and n_B are the transport numbers of the ions A and B in the electrolytes AR and BR.

In deducing this relation it is assumed that the electrolytes are completely dissociated and that the ionic mobilities are constant and independent of the concentration. Kohlrausch's differential equations are only true for continuous transitions of concentrations in the liquid through which an electric current is passing, and cannot be extended as such to the discontinuous transition at the boundary between AR and BR. Both Kohlrausch and Weber recognise this. Of discontinuous transitions they consider in detail the transference of ions across boundaries between two concentrations: (i) of a single electrolyte AR, and (ii) of a mixed solution of several electrolytes with a common ion.

The fundamental assumption of Kohlrausch is the validity of Ohm's Law at all points in the electrolyte, and Kohlrausch shows that the total number of ions of any sign entering or leaving a layer during the interval dt is the same whether the change in concentration is continuous or discontinuous. Both Kohlrausch and Weber conclude that they are justified in treating discontinuous transitions, including that at the boundary between AR and BR, as being a limiting case of continuous transitions, and the mistake which has been overlooked since then consists in considering that the differential equations are applicable to the boundary between AR and BR.

Let us consider a cylindrical tube of unit cross-section containing the boundary and assume that the electrodes are situated at a great distance such that the products of electrolysis do not enter the tube. The concentration of the two electrolytes are related as in equation (1). Now, if a current passes through the tube, there will not be any mixing of the ions A and B, and the condition of electrical neutrality underlying the validity of Ohm's Law would be maintained at and in both sides of the boundary had it not been that more of the ions R leave the layer of the electrolyte BR just contiguous to the boundary than enter it from the layer AR. In other words, there will be an excess of ions B in this layer, which means that Ohm's Law cannot be valid. As a result of this there would be a drag and an adjustment of potential gradient, which for the steady state would mean an equal number of ions R entering and leaving the same layer during the interval dt.

The magnitude of the excess is obviously given by $i.\{(n_R)^{BR}(n_R)^{AR}\}$, where the terms within the brackets are respectively the transport numbers of the ion R in the electrolytes BR and AR. Overlooking for the present the consequent drag on the ions in this layer, we find that a layer of thickness which is equal to $H \,.\, V_R \,.\, dt$, where H is the potential gradient, in the layer BR, and V_R is the mobility of the ions R, will be depleted of all the ions R if we put in these equations the current densities and concentrations used in such experiments. In contrast to the condition in the layer BR, the A ions always move in a 'uniform ionic environment,' as the ions R which move past them always come from the layer of electrolyte AR, and the number thus crossing past the ions A are little, if at all, affected by the drag on the BR side of the boundary.

This consideration also explains why it is necessary to distinguish the electrolyte with the slower moving ion as the 'indicator' solution. This distinction is based on experience, but is not contemplated in the theory of Kohlrausch and Weber. These considerations also explain the observations of Steele, of Abegg and Gauss and subsequent workers, that equation (1) is not sufficient to define the conditions of a sharp boundary even when proper precautions have been taken against the disturbances resulting from the heating effect of the current and from the differences in density. MacInnes has in recent years shown that the adjustment of concentration postulated by Kohlrausch takes place only within a small range of concentrations. A paper containing a fuller treatment has been communicated for publication.

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Porbeagle Shark in the River Towy.

ON Oct. 2 I had a letter from Mr. George M. King, Superintendent of Water Bailiffs for the River Towy Fishery District, recording the capture of an unusua. fish in the Towy on Sept. 30. He enclosed a photo graph, here reproduced (Fig. 1), from which it wa clear that the fish was *Lamna cornubica* Gm., th Porbeagle shark. At my request the fish was afterwards sent on to the National Museum of Wales where it will be mounted.

There are, of course, not a great many definit records of the Porbeagle round our coasts, though th fish is probably not uncommon in some areas. Day, i "The Fishes of Great Britain and Ireland," gives abou twenty-four records for Great Britain and five fo Ireland. Dr. J. Travis Jenkins, in "The Fishes o the British Isles" (1925), adds several more.

As regards Welsh records, Pennant described on from the Menai Straits, whence the species has sometimes been called the Beaumaris shark; one wa washed against a pier at Swansea in a storm i October 1835 (Dillwyn), and picked up nearly dead J. J. Neale, in a paper entitled "Surface Fishes o the Bristol Channel" (*Transactions of the Cardi Naturalists' Society*, vol. 21, part I.; 1889), lists th Porbeagle, but does not refer to any particula instance of its occurrence; Walton, Fleure, and Wright, in an account of the fauna of Cardigan Bay,[1]

[1] "Aberystwyth and District"; a guide prepared for the Conference of the National Union of Teachers, 1911.

include the Porbeagle, but observe that "of course *Lamna cornubica* is merely a very occasional visitor." It is taken from time to time in the Menai Straits (Forrest, "The Vertebrate Fauna of North Wales").

The chief point of interest about the present specimen is that it was caught in a shallow below the point known as the Black Pool—a distance, according to Mr. King, of approximately ten miles from the mouth of the River Towy. According to the statement of the coracle fisherman who caught it, he was returning about 5.30 P.M. from Llanstephan on the first of the tide, which was a 'big spring'—high water at Carmarthen 7.20 P.M.—when he noticed the dorsal fin of the shark cutting the water. He states that he

FIG. 1. [George Weeks.

anchored his boat and went in pursuit; that the fish first retreated into still shallower water, then, to use his own words, "came for me like a bull, but I kicked it." Eventually he finished it off by a blow with an oar.

My informant adds, "It will no doubt interest you to know that several netsmen now inform me that they caught fish during July and August which were so badly scarred as to be unsaleable."

The stomach of the shark was examined here when the fish was received, but was found to be empty. This is not the place to enter into a discussion as to the probability or otherwise of a connexion between the poorness of the Towy fishing during the latter part of the present season and the presence of predatory species in or near the estuary. This note is intended simply to direct attention to the unusual circumstance of a shark being found at such a distance from the sea.

The specimen was 44 inches in length, 33 inches maximum girth, and 36 lb. in weight. It is therefore a small one of its kind, the Porbeagle commonly attaining a length of 8 feet and sometimes of 9 or 10.

COLIN MATHESON.

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The Origin of the Dermis.

IT has been shown by morphological studies that the dermatome of the somites of the vertebrate embryo breaks up into mesenchyme, which becomes the dermis underlying the ectodermal component of the skin of the dorsal and dorso-lateral regions at least. It is frequently assumed in text-books that those same cells spread out under the whole of the epidermis of the embryo and so give rise to the dermis of all regions. In the case of the chick at least, this assumption is not justified, for the mesenchyme derived from the dermatome is indistinguishable from, and becomes mixed with, that derived from other regions. In the course of certain experiments carried out with another object, I have obtained evidence which indicates strongly that the dermis of the limbs and lateral regions, and by implication of the ventral regions, is derived from cells of the somatopleur, not of the dermatome.

The experiments consisted in the grafting upon the chorio-allantois of eight-day chicks of certain regions taken from two-day chicks. The regions used as grafts came from the side of the posterior end of the embryo and were bounded by an anterior line running transversely to the axis of the embryo a little behind the level of the last somite formed, by a line running antero-posteriorly parallel to the axis of the chick and just lateral to the unsegmented vertebral plate, by a posterior line transverse to the axis of the chick and just anterior to the relic of the primitive streak, and by a lateral line parallel to the axis of the chick and lying at or near the periphery of the area pellucida. The grafts thus contained ectoderm, somatopleur, splanchnopleur, and endoderm, but no somites nor somitic derivatives, and no part of the vertebral plate. Obviously no median structures were present.

In addition to cartilages representing an attempt to form limbs, and segments of intestine (in two cases rounded to form tubes), there were present in three cases areas of skin with a definite underlying dermis and young feathers. Evidently, from the nature of the experiment, this dermis cannot have come from dermatome material. Therefore it came from either intra-embryonic somatopleur, chorionic somatopleur, or allantoic splanchnopleur. A number of considerations, the discussion of which would occupy too much space in NATURE, indicate that the dermis was not derived from any chorio-allantoic mesoderm. The main point in this connexion is the inability of chorio-allantoic mesoderm to give rise to feathers even in the presence of epidermis (Hoadley, *Jour. Exp. Zool.*, **43**, p. 179; 1926). Hence the dermis must have come from the grafted somatopleur. The conclusion is drawn that dermis has two sources of origin in embryos: that of the dorsal and dorso-lateral regions is derived from the dermatomes of the somites; that of the limbs, lateral regions, and by implication also of the ventral regions, is derived from the somatopleur.

The question is discussed at greater length in a forthcoming number of the *Australian Journal of Experimental Biology and Medical Science*. I wish to express to the management of this journal my thanks for permission to publish this note.

P. D. F. MURRAY.

The University of Sydney.

Galton's "Life History Album."

In 1902 the second edition of "The Life History Album," by the late Sir Francis Galton, was published by Messrs. Macmillan and Co. Ltd. This album contains blank tables and squared paper by means of which to record the physical and mental development of 'children' from the ages of 0 to 100 years. I have kept (and am continuing) such records of my two daughters from 0 to 22 in one case, and 0 to 15 in the other. Such individual records are of interest to those concerned, but are of little value to biologists unless there are many of them. As the second edition was published twenty-six years ago, there are probably by now several hundreds of these albums containing records, and it would be well if, say, the Galton laboratory had a list of the names and addresses of the owners so that the albums could be borrowed by that laboratory for some particular investigation.

I propose to prepare such a list for presentation to the Galton laboratory, and consequently shall be obliged if those who know of the existence of such albums will kindly send particulars of them to me at 17 Victoria Street, London, S.W.1. It is suggested that the particulars should include:

(1) The name and address of the owner.
(2) The limits of the age of child covered by the records.
(3) The sex of the child.

A. S. E. Ackermann.

17 Victoria Street, Westminster,
London, S.W.1, Aug. 10.

A Simple Method of Distinguishing Plotted Points for Reference.

In plotting the results of experiments it is often necessary to use different marks for points, to distinguish between the results obtained by different investigators or to allow rapid reference to numbered experiments. Circles, dots, triangles, crosses, and coloured inks are commonly used for this purpose, with or without the addition of identifying letters or numbers.

In the case of diagrams, and especially those for small-scale reproduction, the use of coloured inks and letters is often impracticable, so that the stock of distinguishing marks is sometimes quite inadequate.

In work now in hand, I have successfully got over the difficulty by what is believed to be a novel application of the semaphore system. The plotted point is marked in the usual way by either a dot, a small circle, or a large circle, but to its periphery is attached a short line, like the arm of a semaphore. I find that eight positions of the arm at 45° angular displacement can be distinguished quite easily, thus giving twenty-four distinctive marks.

The number can be doubled by adding a short line at right angles to the end of the semaphore arm, thus ♂, and can be increased to seventy-two by a similar addition to the left, thus ♂.

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Sept. 26.

Hybrids of *Ægilops*.

During the last four years I have been engaged in the study of crosses between species of *Ægilops*. One of these, which I wish to record at present, is the hybrid between *A. ovata* L. and *A. cylindrica* Host.; this possesses all the morphological characters of *A. triuncialis* L. and cannot be distinguished from it except that the hybrids so far have proved sterile. I hope shortly to complete the cytological study of the crosses.

I also discovered that the hybrids of *A. triuncialis* with *A. cylindrica* exactly resemble *A. persica* Boiss., now classed by Zhukovsky as a subspecies of *A. triuncialis*. *A. triuncialis* is one of the most widely distributed species of *Ægilops*, its range extending from Portugal throughout the Mediterranean region to Persia and Afghanistan. Systematists recognise a large number of varieties, differing chiefly in the number and length of the awns on the glumes.

I have little doubt that *A. triuncialis* is of hybrid origin, the typical form being the result of hybridisation between *A. ovata* and *A. cylindrica*; the short-awned form, *A. persica*, appears to arise from the back-crossing of the hybrid with the *cylindrica* parent, while the long-awned varieties are doubtless the product of back-crossing with the *A. ovata* parent.

John Percival.

The University, Reading,
Sept. 25.

Can the Hand be thrust in Molten Lead without Injury?

In Nature of Sept. 8, p. 349, Mr. A. S. E. Ackermann asks this question. For many years it has been the practice in this Department to dip the fingers into molten lead when lecturing on the 'spheroidal state' of liquids. No special precautions are taken to free the fingers from grease, as is commonly advised; they are rinsed under the water tap and shaken to remove drops of water. It is even sufficient, if one finger only is to be used, to moisten it by putting it into the mouth. Of course, the fingers do not remain long in the lead, being withdrawn immediately they are covered, though undue haste in dipping and removal spoils the demonstration.

The existence of a badly conducting layer of vapour can also be shown by dipping the dry finger into liquid air. In this experiment, as the hand is hot relative to the liquid, the latter forms its own protective film, whereas in the former case the protection from injury is due to a layer of water vapour.

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Change of Resistance of Lead by the Action of Radium.

While engaged in an investigation to determine the number of free electrons in metals, we have noticed a change in resistance when β particles and γ rays from radium are allowed to impinge on an insulated thin plate of lead. We have further noticed that the change is not permanent and that the resistance varies with time, returning to its original value.

Recently we have noticed that M. Rienci (*Accad. Lincei, Atti*, 7, pp. 400-405, March 1928) has found that the resistance of a thin pellicle of matter increases or decreases according to the nature of the charge, and for the most part the change is permanent.

Any real change in resistance, under the conditions of our experiment, has to be clearly distinguished from thermal effects due to the radiations. As the paper above referred to is not available to us, we are not in a position to know the details of Rienci's experiment.

Work on the subject is proceeding and the results will be published when ready.

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S. Basu.

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Patna.

The Nature of Skill.[1]

By Prof. T. H. PEAR.

THE CONCEPT OF SKILL.

THE word 'skill' is used in many ways. It is therefore reasonable that for scientific purposes its connotation shall be slightly limited. The following is proposed as a definition: *Skill is an integration of well-adjusted performances*. In such a terse statement all the words need explanation and illustration. First, it is useful to contrast skills which come within the range of this definition with that type of adjustment which is a collection of mere habits. I would suggest that the outstanding feature of habit is *specificity*. The experimental work upon transfer of training has made a belief in general habits untenable.

A habit may be defined as an acquired specific response to a specific situation. As soon as we cease to respond specifically, or the situation loses its specific character, our behaviour ceases to be habitual. Skill is dependent upon habit, but not completely. The present suggestion is that, treating the term skill with respect, we should apply it only to the higher types of well-adjusted performance.

Some so-called skills are a fortuitous concourse of habits; and many of these are bad. Often no single habit in the number is well adapted to the task, and the whole collection is only a makeshift, though a makeshift for the whole life of its possessor. Contrast this with the higher skills; integrations, not mere collections of responses, and not necessarily of habits only. Then to describe as skill some industrial occupations, and some forms of domestic service in England, would be flattery.

One of the first analyses of skill was made by Mr. Frank B. Gilbreth. Studying a bricklayer, he found that his eighteen movements in laying a brick could be reduced to five. One may conclude, therefore, that the original performance which he analysed could be called skilled only in the popular sense.

SKILL, CAPACITY, AND ABILITY.

Skill must be distinguished from *capacity* and *ability*. To possess a delicately discriminative inner ear and muscles under perfect control is to have capacity for musical performance. Obviously, such gifts may exist in a person who as yet has shown no musical ability. For he proves his ability to do a thing by doing it. Even by failing he does not necessarily demonstrate his lack of capacity. For if untaught he usually will have tried to do it in the wrong way.

Skill is clearly ability, but ability to do a relatively complicated series of actions easily and well. A man who can run need not be skilled in running. But if he has learnt to move his legs well, to regulate his breathing, to sprint at a particular point or moment, to estimate the time in which it is wise to run a particular lap, to adapt himself to different tracks, different lengths of race, different classes of competition, and different competitors, he possesses skill in running races.

Skill, therefore, implies discrimination of the situation and graduation of the response. But to this should be added what I suggest as the essential characteristic of skill—the ability to *integrate* responses, and in the highest skills to substitute, instantaneously if necessary, one type of integrated response for another. In man, this integration of well-adjusted performances is acquired and fused with natural aptitude, the nature of which will be discussed in a moment.

Those reflex mechanisms which contribute to balance, to the maintenance of posture, and to the efficient co-ordination of action are an important basis of skill. In this sphere we honour the famous contributions of Sherrington, Head, Magnus, and Pavlov, to whose great work, "Conditioned Reflexes," we stand too near to see it in perspective.

Can the physiologist regard skill as entirely an integration of conditioned reflexes? Eventually, perhaps. More than that we cannot say. We are warned not to exaggerate their interpretation. An impressive fact is that to ensure the certain conditioning of a reflex the control of external surroundings must be complete. The necessity, for example, of a sound-proof laboratory, of the absence of the experimenter, to say nothing of spectators, emphasises the specificity both of situation and response. Skill, on the other hand, typically shows itself in the rapid adjustment to a changing environment and to unforeseen conditions.

Comparison of human and animal behaviour has always offered great attractions—and risks—to members of the British Association. Yet I believe that the present comparison is not difficult. While many animals inherit high-grade skills, man does not. Birds inherit skill in nest-building, the kingfisher making one type, the swallow another, and, moreover, selecting different materials.

At birth, man is spectacularly unskilled. The skills which he afterwards acquires are almost entirely determined by his social and material environment. But he compensates for his start from scratch by the number and complexity of the skills which he soon acquires; and of these, language, the raw material of which is speech-habits, is an amazing example.

PATTERNING A CHARACTERISTIC OF SKILL.

The term 'pattern' has appeared frequently in recent psychological writings. But its meanings have been different and not easy to equate. It will be used here simply and objectively to mean an arrangement of human movements in time and space which shows *integrated order*.

Always in theory, and often in practice, such a pattern could be recorded, for example, by Gilbreth's moving, interrupted light fastened to any salient part of the body. Such a pattern could be

[1] From the presidential address to Section J (Psychology) of the British Association, delivered at Glasgow on Sept. 7.

left by the shoes of a dancer, if they were suitably treated. The ice and the snow record beautifully some movements of the skater and the ski-runner. But they receive a trace only of one part of the body. Usually, however, many other parts are simultaneously moving in unison, in harmony, perhaps even in counterpoint. All these spatial and temporal characteristics of pattern could be recorded. But equally important would be the delicate variations in force, corresponding to accent. This integration of the part-actions into wholes usually expresses the individuality of the performer. It is unlikely, for example, that the separate steps of a dance are ever fused into a whole without being changed.

SKILL AND AWARENESS.

Unless and until a highly skilled action has become really automatic, the performer is aware of its integral character. This awareness, unclear though it may be, determines the character of the part-actions. Examples are stress, accent, and intonation in speech. As the sentence is initiated the whole, of which the speaker is aware, determines the parts. To speak a foreign language well, one must raise and lower the voice at points quite different from those which would receive the stress in one's own tongue. To acquire such skill, the learner must attend not so much to the single words as to the whole sentence. This patterning, which dominates corresponding bodily and mental events, acts upon reflex, instinctive and habitual mechanisms. When it employs habits it usually transmutes them into actions less fixed and more adapted to the situation.

'PROPRIA' AND 'ACCIDENTS' OF SKILL.

(*a*) *In Sport.*—One may pertinently inquire if some of the features of ordinary sport-skills are essential or accidental. Borrowing terms from logic, we may inquire if skill has its *propria* and its *accidents*. He who would answer this should purge himself of local and topical prejudices. Many persons assume that skill must consist in the delicate co-ordination of hand and eye and in the timing of complex actions to coincide with a momentary combination of external events. Both these gifts are often indispensable in dealing with a moving ball. But the hurling of missiles is not the only skill to which man aspires. Certain skills are proudly possessed by the blind. Delicate timing enters scarcely at all into many kinds of postural skill, and is seldom necessary for industrial tasks. So probably those subjects which an Englishman would naturally want to study, moving-ball games, should be put late in the programme. More may be hoped at present from the study of postural skills, depending little upon the athlete's 'eye.' Such are swimming, gymnastics, ski-ing, skating, dancing, and eurhythmics.

Sometimes competition in skill is a proprium, sometimes not. The most obvious kind of competition is *destructive*, where A tries to spoil the effect of B's skill, or to prevent it, as in boxing, fencing, football, and hockey. Cricket and tennis involve semi-destructive competition, through prohibitions of space. Your cross-court shot may merely amuse your opponent, but at least it lived from your racket to the net.

In many sports the competition is non-destructive. The performances may even be successive, with every chance for the competitor to do his best; and for this reason I believe they will the sooner repay study. Smith's six-foot high-jump can never be spoiled by Jones collaring him low at the take-off.

These distinctions may be obvious. But I have never seen them made in scientific discussions of skill. A little less obvious, perhaps, is the thought that different types of competition are excelled in by persons of different temperaments. Too much of the fighter's spirit and too little of the artist's and thinker's may lose many games.

In many skills emotion is an 'accident.' Obviously a player should keep his head. But coolness may be but indirectly related to skill. Some play better when keyed up, fearing nerves less than stodginess; some wilt at the thought of spectators; others admit, even seek, the inspiration of a friendly and understanding crowd. Though emotion as an accidental factor may help or hinder the expression of skill, yet in music and acting it may blend with and form an integral part of the expression. Actors, for example, sometimes genuinely feel the emotion which they are portraying.

(*b*) *In Work.*—Thus far an attempt has been made to filter the general concept of skill and to reject irrelevant meanings. In dealing with industrial skill I am indebted to an article by Miss Anna Bezanson. She writes (*Quarterly Journal of Economics*, vol. 36, pp. 626-645; 1921-22): "Considering the glibness with which workmen are pigeon-holed as 'skilled,' 'semi-skilled,' and 'labourers' in many industries, it is surprising to find little definition of what constitutes skill or lack of skill. Everyone takes it for granted that precisely what he means is understood by referring to a workman as possessed of 'skill.'"

We may utilise Miss Bezanson's collection of 'accidental' factors in industrial skill.

(1) *Accepting Responsibility for many Independent Decisions.*—Though arriving at these decisions may involve skill, the acceptance of responsibility is due to other factors.

(2) *Learning about the Capabilities of Materials.*—This involves the ordinary processes of acquiring knowledge. Muscular or kinæsthetic knowledge can only be obtained by doing. But with the progress of science it is every day easier to get from books knowledge which was formerly locked up in the skill, real or alleged, of the professional.

(3) *The possession of judgment and knowledge concerning apparently 'outside' jobs* may rank a person as skilled in the primary occupation. In practice this may be important. Its theoretical meaning is simply that other things, including intensity, being equal, the greater the extensity of skill the better.

(4) *The Ability to transfer Knowledge and Skill to a Different Industry and to Different Material.*—This

raises the question of the relation between general and specific training in a pleasingly concrete and useful form. Actually it does so twice, once in the realm of knowledge and once in the realm of power.

A special instance of the interrelations between mental abilities (and bodily ones) is raised in the consideration of

(5) *Keenness of Perception.*—In theory, keenness of perception, which means fine sensory discrimination, for example, of colours and tones, or perceptual discrimination, for example, of shapes or patterns (not, of course, visual only), might or might not be linked to superlative skill. The method of correlation makes it possible to investigate this relationship. Pioneer work has already been done by Prof. Carl E. Seashore in the investigation of musical talent. But, while it is unlikely that superlative skill will ever be found linked to subnormal discrimination, a high correlation between them cannot be assumed; and the correlation between sensory discrimination and general intelligence, though usually positive, is very low.

(6) *Appreciation of the Interrelation of Factory Processes.*—This involves intelligence rather than skill. But success in appreciating any relations may depend upon the way in which the data have been vouchsafed, and the extent to which they are obscured or illuminated by well-meant and enthusiastic 'explanation.' Explaining complex matters usually requires a skilled explainer. The skilled performer often does it especially badly.

A GENERAL CLASSIFICATION OF SKILLS.

We may now attempt to classify skills, working upwards from the lowest type.

(1) *Collections of imperfectly adapted Responses.*—This class includes much domestic work, the skill of most labourers and of workers in the semi-skilled trades.

(2) *Perfectly adapted Responses which do not exhibit Personality.*—Such are the movements on parade of the perfectly drilled soldier. Military skill of this kind may be compared with the skill which would result in industry if a stereotyped series of actions, however efficient, were rigidly prescribed to the worker. Its advantages and defects are clear in military organisation.

(3) *Responses resembling Habits, but less Specific and Automatic.*—The importance and distinctive nature of such responses make one doubt the wisdom of classing them with habits. For habitual actions are inadequate to the situations which these others meet so very perfectly. Such responses are exemplified in sport when rapid, delicately effective complex adjustment is made towards the surface upon which the player is moving, for example, wet and dry, hard and grass tennis courts, heavy and light football grounds, hard, soft, smooth, and bumpy ice, and different hardnesses and elevations of snow-slopes. Such adjustments appear neither to the understanding external observer to be mechanical, nor subjectively to their performer to be unconscious.

This adaptation may be effected to conditions both outside and inside the body. A performer who is feeling ill, without decreasing control, may modify his movements so that less strain is put upon his muscles. A first-class automobile driver's adaptive behaviour in traffic makes the average motorist look like the bundle of habits which some pessimists declare man to be.

(4) *Responses like those in* (3), *but exhibiting in their Totality a Pattern characteristic of the Individual.*—This pattern may be original or unoriginal. A style which appears to the spectator to be unique may have been imparted by a teacher, though to it the pupil usually adds some personal touches.

Types (3) and (4) shade into each other, though in (4) an aspect implicit in (3) is emphasised. Probably these are in the minds of the protesters against the standardisation of industrial tasks.

(5) *Creative Skill.*—In this realm two kinds of creation may be distinguished. One is unconscious, or nearly so, as when a pioneer declares that his work finds its way out of him. Perhaps we may call it the artistic kind. The other results from deliberate analysis of earlier attempts, satisfactory to the ordinary person (a host of problems are covered by the word 'complacency'), but provoking to the genius.

Such analysis may involve recall in memory (visual, muscular, and verbal) of various skilled feats, comparison and discrimination between them, selection of their relevant aspects, re-comparison with some aim in view, re-combination, and, as a result, an unanalysed — perhaps unanalysable — polish which fuses the movements into a dazzling new unity. This is inventive creation in skill resulting from analysis. It is seen and will be seen oftener in the world of play and art. It may increase in the world of industry, if industry desires and deserves it.

RELATION BETWEEN DIFFERENT MOTOR ABILITIES.

Tests of intelligence give results which correlate highly with each other. But there is no justified single concept enabling us to explain why some persons seem generally clever with their muscles. While there seems ample evidence for the existence of general intelligence, the results of simple tests for isolated motor performances from which intelligence has been excluded, so far as possible, give extremely low or negative correlations with each other. Moreover, these results do not warrant belief in any special connexion of simple motor abilities with intelligence.

From these results far-reaching deductions have been made by some writers. One is that there is no general capacity, no 'motor type' of person. The conclusion concerning vocational tests has been drawn that tests for ability in any performance give valid results only when the test performance is identical with that for which the test is being administered. They support the 'sample' as against the 'analogous' test.

Yet an alternative explanation of Perrin's and Muscio's findings is possible, based upon a suggestion made by Sir Henry Head to the present

writer. Their tests involve the simplest muscular co-ordinations. Many of them were confined to limited parts of the body. From the tests used by Muscio, demands upon intelligence were excluded.

As a consequence, the bodily mechanisms involved may have been controlled by relatively low levels of the nervous system. The significance of the test results, therefore, would not exclude the possibility that in *skilled* performances a higher, more complex power might employ and co-ordinate the simple mechanisms.

The above tests, therefore, being concerned with simple motor abilities, are important for the study of skill, rather as suggesting lines of inquiry than as affording data.

TRANSFER OF TRAINING BETWEEN MOTOR ABILITIES.

Another method of attacking this problem is to re-set it in the well-known form of the transfer of training. Subjects are intensively trained in some skilled activity until their curves of practice have shown a marked rise over a fairly long period. One discovers then if the undoubted ability gained in the test activity has been transferred to apparently related or similar performances. Many 'controls' are needed in such an experiment.

An extensive investigation into transfer of training in a low-grade skill was recently carried out in the Manchester laboratory by J. N. Langdon and Edna M. Yates. Possibly for the first time in such experiments a number of conditions were rigidly observed. These were the domination of the learners' motives, the selection of a really skilled performance, though a simple one, as the test activity, the testing of similar control subjects in strictly comparable conditions, and the simultaneous provision of 'analytic' tests, that is, tests of simple powers which appeared to be components of the training activity.

The operation selected for intensive training was modified from one in the driving-chain industry. The subject sits before a small turntable. It carries fixed pairs of spindles upon which links have been placed. As he brings each of these in turn before him, he removes it from the turntable, dropping the link into a box at his right hand. Simultaneously he takes another link from a box at his left and places it upon the pair of spindles, reinstating the whole upon the turntable. He then rotates the turntable, bringing the next unit into position, and repeats the whole operation.

Thirty-two unemployed boys aged sixteen, paid at a high piece-rate, were thus trained, each for two weeks. These constituted the 'trained group.' Before training, each boy's performance was measured in the various tests designed to detect the presence of transfer, if any. These had been selected after a careful observational analysis of the operation with the links and spindles. Most of them were simple tests of manual dexterity, such as inserting matches in holes, filling a box with matches, slipping curtain-rings over a rod, threading links with twine, reproducing from memory the angle of an arm movement, or the force with which a recording anvil had been struck by the subject's hammer, static and dynamic steadiness, and—to discover if the training in the skilled action had affected more purely 'mental' functions—tests in mental arithmetic and tests involving the rapid and accurate cancellation of specified letters in a page of print.

This series of tests was given on three occasions: (1) before training, (2) at the end of the first week, (3) at the end of the fortnight. They may be called transfer tests, 1, 2, and 3. Identical tests were given, in the same order and at the expiration of the same three periods, to twenty-eight similar subjects who meanwhile received no training. These were the control group.

Since the trained group contained thirty-two, and the control group twenty-eight subjects, statistical treatment is justifiable. In no instance was the difference between the trained and the control group, with regard to their improvement in transfer test 3 as compared with 1, of such a magnitude as to exclude the possibility of its being due to chance factors. In some results the brief practice afforded by the test itself was definitely shown to have had more effect than the intensive training in an apparently analogous performance.

The experiment supports the view that in such conditions training in a low-grade skill is specific rather than general. These manual habits did not transfer. How may such a clear-cut result be explained? The following considerations may be suggested: Writers upon transfer of training who know the experimental evidence believe that one of the chief agents of transfer is the formation of a sentiment. In the present experiment there was no encouragement to form a general sentiment about the acquisition of skill, which might spread to other skills.

The conditions were as unsentimental as might be. The workers were never exhorted to do their best. The only encouragement was the very real one of immediate personal gain. Conversely, slack work automatically caused less pay. This was made known to the learner with little delay. The personal influence of the experimenters was as little and as unchanged as possible. The workers were paid, and highly paid, to transfer. Yet demonstrable transfer did not occur.

The evidence seems now to establish that the problem of transfer may be divided into two parts:

(*a*) Transfer resulting from and due merely to exercise of any particular function.

(*b*) Transfer resulting from extension of attitudes, sentiments, ideals, or knowledge of methods, where the particular function trained was the vehicle of these mental powers.

It now seems certain that (*a*) is rare, and that (*b*) definitely can occur. But in educational institutions, where subjects or parts of subjects are taught by different persons, the chances of transfer through common applicable methods discovered by the learner himself, or through sentiments, is much less; and the automatic occurrence of transfer can never in the future be *assumed* by anyone conversant with the facts.

The World Fuel Conference.

THE purpose of the World Power Conference is to consider how the industrial and scientific sources of power may be adjusted nationally and internationally; and the sectional meeting of this Conference which was held on Sept. 23–Oct. 6 to deal with fuel problems has undoubtedly contributed materially towards the furtherance of this object. The first plenary World Power Conference, held at Wembley in 1924, dealt in the broadest possible manner with power and its uses, and was a real attempt to see the world as an economic whole. Problems of the greatest importance were raised, which indicated the desirability of further meetings to discuss various sections of the subject in a more specialised manner. Thus, in 1926 a sectional meeting, limited to the discussion of water-power problems, was held appropriately at Basle. The recent Conference was devoted to the subject of fuel, the winning, preparation, transport, and utilisation of which are subjects commanding the attention of industrialists and technicians throughout the world.

Coal is the chief basis of the world's fuel requirements, and in Great Britain, perhaps more so than in any other country, it constitutes the main driving force in our industrial civilisation. That delegates from 48 different countries attended the conference, and that 175 papers, written by the world's leading authorities, were presented, testify not only to the universal interest taken in the subject, but also to a clear recognition of the value of a pooling of knowledge as a powerful weapon of attack against world-wide problems such as, for example, the present depression in the coal-mining industry, which is not confined to Great Britain alone, but is international in scope.

At the inaugural meeting on Sept. 24, over which the Marquess of Reading presided, Sir Robert Horne in his opening speech made no secret of the great importance which the British Government attaches to the question of fuel and its economic use. As he pointed out, Great Britain, of all countries, stands perhaps to gain most from the accumulated experiences laid before the Conference by the world's experts; for "the modern prosperity of Great Britain was created by coal, and by coal it will be saved," declared Sir Robert, "but it will only be by adopting improved and more economical methods of using it."

The undoubted success of the Conference was largely due to the most efficient manner in which it was organised. No effort had been spared to ensure the smooth running of the meetings and the comfort and convenience of the visiting delegates. The papers, many of which will rank as valuable monographs on the subjects dealt with, were divided into appropriate sections, to each of which a session was devoted. At such meetings the papers were taken as read, the proceedings being opened by the reading of a résumé of the material contents of the papers under consideration. These were drawn up by the general reporter appointed to each section and, without exception, they summarised clearly and concisely the subject matter dealt with, though occasionally the reports may have tended to be slightly coloured by the reporter's own views. The ensuing discussions which, thanks to the linguistic abilities of the foreign delegates, were conducted almost entirely in English, were likewise well organised and there was little, if any, straying from the real matter in hand.

The scope of the Conference was wide, embracing, first of all, the economics of the coal industry and the storage, transport, and treatment of coal; secondly, the oil industry in relation to the preparation and use of liquid fuels; thirdly, the carbonisation industries, with special reference to high and low temperature carbonisation and the better utilisation of coke oven gas, of which a large surplus supply is available in Great Britain.

Further sessions were devoted to the generation of steam and electricity, both for industrial and domestic purposes. Research and development in all countries have been brought to bear on the attainment of higher thermal efficiencies, particularly in the generation of electricity from low-grade and waste fuels, and also on the co-operation of separate industries in the linking up of energy in all forms with the view of avoiding waste. In connexion with this, great progress was foreshadowed in suggestions put forward for a more rational grouping and centralisation of units concerned in the manufacture of iron and steel; for example, coal mine, coke-oven, blast and reheating furnaces, steel-works and rolling mills, and possibly even town's gas supply plant. The achievements of the Dunston plant of the Newcastle Electric Supply Company, where low-temperature carbonisation and electricity generation have been successfully combined during the past three years, afford convincing evidence of the advantages of such grouping.

The subject of pulverised coal aroused much interest, and it seems that its introduction, where circumstances are favourable, may lead to greatly enhanced efficiencies; in marine steam generation, in particular, great possibilities are predicted. Attention was also directed to the economic advantages of both high pressure and high temperature steam, upon which intensive research is being prosecuted on an international basis. It is hoped that the results will be available shortly.

As perhaps was to a large extent unavoidable in a conference of this nature, one important consumer of fuel received less sympathetic attention than his case undoubtedly merits; we refer to the domestic user, who in Great Britain burns 23·0 per cent of our total coal production and

thus consumes more raw coal than all the railways and gas and electrical undertakings put together. The layman may or may not be aware of the fact that he pays more than twice as much for coal as the large industrial consumer; he certainly does not know that at the same time he pays more than double for an inferior product. Scientific classification, analysis, and quantity form the basis upon which industry buys coal; the domestic user just buys coal, so many hundredweights or tons at a time, with no indication as to its quality other than some usually meaningless fancy name, and without any guarantee as to its ash (and stone!) contents, its calorific value, or its nature. He must also buy his 'pig in a poke,' whether he likes it or not; the middleman, while more than doubling the cost of the private consumer's coal, also sees to it that he is steered clear of all such queer new-fangled notions as calories and so forth.

Coal alone does not form, however, the sum of the private consumer's fuel and power requirements; the gas and electricity undertakings are there to push their goods. How pathetic is the domestic user's attitude of indecision when coal, gas, and electrical interests, each and all for themselves, and with all the highly organised and well-trained powers of persuasion at their command, set about convincing him that theirs is the one and only satisfactory solution of his heating problems? It seems to us that the time has come when the domestic user should be able to turn to some disinterested body for unbiased advice as to when, how, and where to use coal and other solid (or liquid) fuels, gas, and electricity; a body which would also see to it that the fuel he bought was purchased on a basis not only of quantity but also of quality. It is useless to attack the domestic open grate fire and to demand its abolition. It is true that when burning raw coal it is the arch polluter of the atmospheres of our cities: but the blood of fire-worshipping ancestors still flows in the Englishman's veins, and to him central heating is an insidious and stuffy abomination and the gas fire a glaring and inhospitable object; the open fire alone can minister satisfactorily to his physiological and psychological needs in the home. Thus, the only remedy for smoke pollution lies in giving the householder a fuel which will burn as well as coal but without smoke, not only on special but also on existing open grates. Up to the present no such fuel has been available, and, until it is, the politician's parrot cry of 'the wicked waste of raw coal on open fires' is meaningless.

A wider interest than the purely technical attaches to the World Power Conference. The proceedings have afforded ample evidence of the efforts that are being made to combine the spirit of individual enterprise with the spirit of co-operation in the examination of all problems besetting those interested in fuels and their utilisation. This spirit of co-operation is being fostered not only between industries which, like the gas and electrical undertakings, were formerly considered to be antagonistic, but also in industry the world over. It would be difficult to overrate the value of this aspect of the Conference towards the firmer establishment of international goodwill; for, as Sir Thomas Holland pointed out in his opening address to Section F of the Conference, the surest basis of a world peace lies in a mutual understanding and co-operation of economic interests and resources.

Foot-and-Mouth Disease.

PROGRESS in the prevention and cure of foot-and-mouth disease is hampered by the fact that no method has yet been devised for cultivating the virus *in vitro*; and since it cannot be seen, it can only be propagated and recognised by the inoculation of susceptible animals. Further, the control of the disease is rendered more difficult by the fact that at least three types of the virus are known: immunity produced by an attack due to one type does not render the animal any the less susceptible to attack by one of the other types; and, finally, the immunity produced is only relatively short-lived. In spite of these handicaps, the Third Progress Report of the Foot-and-Mouth Disease Research Committee, 1928,[1] gives a detailed account of much research work directed towards increasing our knowledge of the natural history of the disease, and of methods of destroying the virus and of producing immunity in susceptible animals. Owing to the reconstruction of the Experimental Station at Pirbright, the work has been confined to experiments on small laboratory animals—guinea-pigs and rabbits,—other rodents possessing a high degree of natural resistance,—carried out at New Haw, the Lister Institute, and the National Institute for Medical Research.

Some attempts to cultivate the virus *in vitro* were uniformly unsuccessful, even when the oxygen tension of the medium was reduced to nil by the addition to it of small quantities of cysteine (Y. M. Burbury).

The distribution, localisation, and disappearance of the virus in animals after inoculation have been studied by M. C. Maitland, and I. A. Galloway and S. Nicolau: the latter authors have also made an extensive histological study of the lesions in the tongues of rabbits and guinea-pigs. It appears that the predilection of the virus for the soles of the feet and the mucous membrane of the mouth is associated rather with the fact that these areas are subjected to movement and pressure than due to their freedom from hair. If a strip of hairy skin is transplanted on to the sole of a guinea-pig's foot,

[1] Ministry of Agriculture and Fisheries. Third Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 141+22 plates. (London: H.M. Stationery Office, 1928.) 5s. net.

vesicle formation will occur in it, whether the virus is inoculated intradermally into the transplant or intramuscularly elsewhere, although lesions scarcely ever occur in hairy skin elsewhere. If, on the other hand, a foot is immobilised and protected by a pad from pressure, vesicle formation does not occur in it following the intramuscular injection of a large dose of virus.

Multiplication of the virus is associated with this vesicle formation, and occurs in both the primary vesicle at the site of inoculation as well as in the secondary vesicles developing upon the feet and tongue within twenty-four hours: infection can be caused by a drop of vesicle fluid diluted a million times. On the other hand, although the virus can be found in the blood and certain of the internal organs for the first three days after infection, it does not apparently multiply in these situations, and no lesions can be discovered in the latter on microscopic examination. In the case of the feet and tongue, virus can be recovered up to the eighth day after infection. It thus appears that in these small animals a process of natural cure takes place, with disappearance of the virus after a few days: very rarely does an animal act as a carrier of the virus for a longer period.

Histological examination of the tongue shows that the earliest evidence of a lesion is degeneration of a small group of epithelial cells: the degenerated area increases in size, a few polymorphonuclear leucocytes wander in and also degenerate, and these disintegrated cells, together with some fluid, form a vesicle, which increases in size and finally bursts, leaving an ulcer, which heals under a scab. Some polynuclear infiltration occurs also in the corium, but a severe inflammatory reaction only occurs if secondary infection of the ulcer takes place.

The immunity produced by an attack of the disease is only short-lived, about 6-12 months: in addition, three distinct types of virus are now known to exist, and an infection by one type will not produce the slightest immunity to either of the others. The blood of an animal recovered from the disease contains antibodies, which can be demonstrated by its power of destroying the virus *in vitro*.

Adequately to control outbreaks of the disease, knowledge of the power of survival of the virus outside the body and of methods of destroying it is essential. It is known to survive in vesicle fluid, in the epithelium from blisters, and in the internal organs, for months, if chilled, provided the animal was killed during the first few days of infection, since later, as mentioned above, the virus rapidly disappears from the tissues. On a glass slide it will survive for at least two years in chemically dry air; in ordinary moist room air it dies within a week: survival under ordinary conditions is longer on hay and bran than on cotton-wool and filter paper, but in all cases a damp atmosphere has a deleterious influence; thus on moist hay or bran it only lives five days, on dry hay it may survive for several months. In these circumstances methods of sterilising materials likely to be contaminated with virus are of great importance. In vesicle fluid, formalin, phenol, and mercuric chloride have a relatively low disinfectant power as compared with free chlorine or iodine, or potassium permanganate. In the presence of particulate organic matter, however, the value of the oxidising disinfectants is considerably reduced, whilst that of phenol, cresol, or formalin is comparatively unchanged. It was found that spraying hay with one per cent formalin and allowing the solution to evaporate, destroyed the virus dried on it (F. C. Minett). Hides could also be disinfected by soaking for forty-eight hours in the same solution, but unfortunately this treatment affected them deleteriously.

The virus is fairly easily destroyed by heat, a very short exposure to water at 60° C. being effective: at 50° C., blood is rendered non-infective after about four and a half hours at this temperature.

The control of the disease, apart from the slaughtering of infected animals, must be based on disinfection of infected material, treatment of infected animals both by specific and non-specific remedies, and finally by prevention of infection by artificial immunisation: it is obvious that if all animals could be rendered immune, the disease would vanish. The fact that immunity is short-lived will always militate against the success of immunisation: on the other hand, there is no evidence at present that wild rodents can carry the disease and act as a source of infection for cattle: rabbits, for example, can be inoculated with the virus and develop the disease, but will not pass it on to others of the same species kept in close contact with them. The problem, then, is that of immunising the larger animals in which the disease naturally occurs.

The method of immunisation by injection of virus of low virulence cannot be of wide application owing to the danger of spread of the infection: injection of serum from an immune animal will only protect for 10-14 days: injection of virus and serum together may produce satisfactory results, but they are too variable for the method to be of much practical use. Vaccination by means of killed virus is the method of choice, provided that a satisfactory vaccine can be obtained. H. B. Maitland has found that a vaccine prepared by exposing the virus to 0·1 per cent formalin at 26° C. for 48 hours at pH 7·6 gives satisfactory results in guinea-pigs: the immunity is fully established in four days, and is effective for four months, but is not so complete as that produced by injection of living virus, since local inoculation of the feet will produce vesicles, although further generalisation of the disease does not occur. The results, however, suggest that a suitable method of vaccination will soon be discovered. It is also probable that progress in the application of specific prophylactic and therapeutic methods will be aided by the recent observation of Prof. A. Ciuca that the method of complement fixation can be used to show the presence or absence of immunity in susceptible animals.

News and Views.

THE Mathematical Tripos list of 1880 is probably the only list of its kind which has produced three professors for the University of Cambridge—Sir Joseph Larmor, Prof. H. F. Newall, and Sir Joseph Thomson. Happily, all three are still actively at work, though Prof. Newall has announced his coming retirement. Formerly assistant to the Cavendish professor and demonstrator in experimental physics in the Cavendish Laboratory, he became Newall observer in charge of the 25-inch Newall refractor when, in 1890, his father, Mr. R. S. Newall, F.R.S., presented it to the University of Cambridge. In his hands the Newall dome became an active centre of pioneer astrophysical research and the seed of a large and growing department in the University. First of all, in 1907, a Littrow spectrograph fed by a cœlostat and a lens of 60 ft. focal length was provided from the bequest of Mr. Frank McClean; then, in 1908, the telescopes with which Sir William Huggins had carried out his pioneer investigations on stellar spectra were presented to the University by the Royal Society, while the whole establishment under Prof. Newall's direction was greatly increased when, in 1911, the University accepted the charge of the Solar Physics Observatory on its transfer from South Kensington, and Prof. Newall became its director. He had already, in 1909, become professor of astrophysics and a fellow of Trinity College. In addition to astrophysics and solar physics, Prof. Newall has throughout actively fostered in the Observatory research in meteorological physics. He has been for many years an elector to the Isaac Newton Studentships, and in that work, as also through the Observatory Club which he founded in 1909, he has exercised a marked influence on generations of the younger students in astronomy. In his retirement, with greater freedom from administrative cares and more time to complete his own work, it may be hoped that his knowledge and influence may make themselves felt for many years to the continued benefit of the science to which he has devoted himself.

BY unanimous choice Dr. Robert Ranulph Marett was elected Rector of Exeter College, Oxford, on Oct. 9, in succession to Dr. L. R. Farnell, who resigned that office recently. Dr. Marett, who was educated at Victoria College, Jersey, and was a Domus Exhibitioner of Balliol College, was elected a fellow and tutor of Exeter in 1891, after taking first classes in Classical Honour Moderations and Literæ Humaniores. He won the Chancellor's prize for Latin verse in 1887, and the Green prize in moral philosophy for an essay on "The Ethics of Savage Races" in 1893. From 1893 until 1898 he served his college as subrector and was one of the University proctors in 1918. Dr. Marett's interest in the culture of primitive races, which had been shown in his Green prize essay, though outside the straiter lines of academic philosophy, gave his lectures a breadth and unconventionality which was not without effect on the men who came under his hand, and marked him as the obvious man for the appointment of secretary of the Committee for Anthropology when that body was formed some twenty years ago. He was also made reader in social anthropology. In both capacities he has exercised considerable influence in the movement for the training in anthropology of officials who administer native affairs in the dependencies of Great Britain. Dr. Marett is the author of "Anthropology" in the Home University Library, "The Threshold of Religion," "Psychology and Folklore," and a number of papers in scientific periodicals. He has been president of the Anthropological Section of the British Association and also of the Folklore Society, and took a prominent part in the excavation of the palæolithic cave of St. Brelade, Jersey, in which a tooth of Neanderthal man was found.

AMONG the questions of general scientific interest likely to engage the attention of the British Association when it visits South Africa next year, one of the most widely discussed is the origin, history, and purpose of the prehistoric ruins at Zimbabwe and similar sites chiefly, though not exclusively, in Southern Rhodesia. These monuments have been repeatedly described and partially explored; and on the British Association's previous visit to South Africa in 1905 many points were cleared up by the very careful studies of Dr. Randall MacIver. But since 1905, besides the valuable work of local archæologists, and Government measures of conservation, discoveries elsewhere of monuments claimed as comparable, have made further excavation desirable. Accordingly, as soon as the South African meeting was arranged, the British Association appointed a committee on South African archæology: ascertained that the government of Southern Rhodesia would welcome such an investigation; and in response to a similar suggestion on the part of the Rhodes Trustees, guaranteed the necessary funds. The council of the Association has now appointed to conduct the investigation, Miss Gertrude Caton Thompson, who has varied experience as an excavator in Egypt and Malta. Miss Caton Thompson will probably arrive in South Africa early in 1929 and visit sites and museums until the season permits of excavation on the site selected as most likely to yield evidence as to the history of the whole group of monuments. As it is understood that there is already one other expedition in South Africa engaged in prehistoric studies, and that communications may be expected on remains of similar character in other parts of the continent, it will be seen that at the British Association's meeting full justice is likely to be done to this obscure and fascinating problem.

THE third and largest of the hydro-electric power generating stations of the North Wales Power Company at Maentwrog was formally opened on Oct. 15. This station is the direct outcome of the work done by the Electricity Commissioners in 1923, when they surveyed the requirements of North Wales. The Company has already 340 miles of main transmission lines in operation, and bulk supplies are given to 15 large and 21 smaller electric supply companies and local authorities, and to 23 large industrial undertakings.

These include slate and granite quarries, cement works, collieries, and the L. M. and S. Railway engineering works at Crewe. The Company supplies an area of over 4000 square miles, and so great is the demand for electric power that a supplementary bulk supply is taken from the Mersey Power Company's steam station at Runcorn. The new power house will supply immediately over 20,000 kilowatts. An artificial lake about two square miles in area has been constructed by damming the river Pryson in the Vale of Festiniog. At present the depth of the water behind the main dam is only 25 feet, owing to the low rainfall this year, but after the winter rains it is expected to reach the spillway level, and it will then be 48 feet deep. The effective head of the water obtained at the foot of the high pressure pipe line at the power station is 630 feet. Under this pressure the water turbines, which are of the double jet type, run at 333 revolutions per minute. For Wrexham and Crewe the voltage is transformed up to 66,000. The mains are carried by white-painted, latticed-steel towers, spaced 180 feet apart, and every care has been taken to make them as artistic as possible. The steel-cored aluminium conductors hang in graceful curves between them. The artificial lake is considered to add to the beauty of the Vale of Festiniog.

AT a meeting of the Eugenics Society, held on Oct. 10 in the rooms of the Linnean Society, Major Leonard Darwin was presented with his portrait in oils as a token of appreciation of his services during the seventeen years he has acted as president of the Society. Prof. E. W. MacBride, who made the presentation, said that Major Darwin has seen the Society grow from a handful of people, who might justly be described as a group of eccentrics, to an earnest, level-headed body intent on facing the social problems of the day. This change has been largely due to Major Darwin's wise and moderating influence. Bringing to the Society the prestige of a name universally honoured in biological science and the practical sense of a politician, he saw that the improvement of social affairs is not to be attained by the selection of persons of exceptional abilities, their forced mating and the endowment of their offspring at the public expense, but by the gradual elimination of the unfit, as this is the method universally adopted by Nature for keeping the populations of the lower animals in a healthy condition. This elimination in the past has been effected by the awful toll exacted by disease on young children, and such a toll will continue to be exacted if the reckless reproduction of the unfit goes on. Major Darwin has never wearied in his insistence on the necessity of adopting measures to prevent the unfit from marrying, and there are signs that the essential truth of his position is forcing itself on public opinion. Prof. MacBride predicted that in times to come Major Darwin will be regarded as the founder of sane views on population and society, just as his father is justly regarded as the founder of modern biology.

THE American Institute of Weights and Measures in pursuance of its main policy of defending the use and preserving the legal status of the system of weights and measures based on the yard and pound, has declared itself ambitious to secure that material official standards be sent from the United States of America for comparison with the British Imperial Standards in 1932, when the next decennial comparison of the latter with their Parliamentary copies takes place. As mentioned in these columns on Aug. 4, p. 179, the Institute regards the present official recognition of the superior status of the metric units as constitutionally irregular and suspects the administration of fostering pro-metric tendencies. In a paper entitled " A Precision Value for the Inch," published as one of the Scientific Papers of the Institute (in format closely resembling those of the U.S.A. Bureau of Standards), Luther D. Burlingame proposes that the United States of America, Great Britain, Canada, and other British Commonwealths should accept the International Metre as stabilised at 1,553,164·13 times the wave-length of the red ray of cadmium and agree to define a precision inch as a fundamental unit for practical use, equal to 25·4 millimetres or 39.450¼ wave-lengths. Whatever practical virtues this proposal may possess, the arguments employed in its justification are not altogether sound. For example, it is stated that the Order in Council of 1898 *defines* the yard as 0·914399 metre, whereas it merely authorised this value as a conversion factor, resulting from the most reliable experimental results then obtainable, without any prejudice to the definition of the yard in terms of the material standard bar as laid down in the Act of 1878.

THE *Graf Zeppelin* (LZ127), which started from Friedrichshafen on Oct. 11, arrived at Lakehurst Naval Airship Station in the United States on Sunday last, after a stormy voyage of 112 hours. The attempt to avoid the bad weather of the northern route across the Atlantic, covered by the R34 in 108 hours, was not successful, and the stabilising surface was damaged seriously by a squall. The excitement in Germany over the safe arrival is a measure of the anxiety which accompanied the fragile giant on its voyage, and of the intense hopes which have been placed in a legendary 'freedom of the air.' The German constructors have very much wider and more continuous experience in the design, construction, and handling of airships than the rest of the world, as is evidenced by the serial number LZ127. The *Graf Zeppelin* is larger, more powerful, and more costly than its predecessors, and will in turn be surpassed by the British airships R100 and R101 now under construction. The damage to the stabiliser was not vital, but is a serious symptom of structural weakness. The delay in starting, the slowness and stormy nature of the passage in spite of meteorological information, the limited number of passengers and the heavy cost of building and running, all lead to a belief that a commercial service of airships is impracticable with the materials at disposal.

THE following details of the *Graf Zeppelin* are given in the German technical press: Length, 237 metres; mean diameter, 32 metres; power, 5 × 400 k.w.

Maybach engines in separate external gondolas; volume, 105,000 cubic metres; gross lift, 110 metric tons; speed, 110-130 km. per hour. Experiments have been carried out on a gaseous fuel of the same density as the air with some success, but difficulties of supply have prevented its adoption for the *Graf Zeppelin.*

Two flying expeditions are now on their way to the Antarctic by steamer. A dispatch from Sir Hubert Wilkins to the *Times* announced that he had arrived at Monte Video and intended to sail on Oct. 24 in a Norwegian whaler for Deception Island, the whaling base in the South Shetlands. He is taking with him two Lockheed Vega seaplanes. Accompanying him are Lieut. Eielson, Mr. J. Crossan, and two mechanics. Sir Hubert Wilkins' plan, as originally announced, was to take off from a whaler in the Ross Sea and fly across the edge of the Antarctic continent to Deception Island, a distance of some three thousand miles. Com. R. E. Byrd is now on his way to the Ross Sea with another expedition. He proposes to make his base at the Bay of Whales on the Ice Barrier, and fly southward towards the Pole.

On the evening of Tuesday, Oct. 16, the president, council, and fellows of the Royal Anthropological Institute were entertained at a conversazione at the Wellcome Historical Medical Museum, by invitation of the Director, Dr. Henry Wellcome. A large number of fellows and other distinguished guests, who had been invited to meet them, were present. In the course of the evening Miss Blackman gave a demonstration of the magico-medical methods of the fellahin of Egypt, using for the purpose specimens which for the most part had been collected by her for the Museum. The fellows and other guests had then an opportunity of examining the collections, which to a great extent have been, and still are, in process of rearrangement under the present conservator, Mr. L. W. G. Malcolm. Originally started by Dr. Wellcome as a collection to illustrate the history of medicine, the Museum is now one of the most important collections in the world illustrating both the history of medical and surgical science and the magico-religious ideas from which those sciences have developed among savages and as they survive among the folk of civilised peoples. Owing to lack of space, only a small part of Dr. Wellcome's collections can at present be inspected by the public; but when fully displayed they will illustrate the development of human thought and culture in a manner which will be unrivalled even in public institutions.

Another violent earthquake occurred off the Mexican coast on the night of Oct. 8 (local time), by which nine States were shaken. It was recorded at Kew at 3 hr. 13 min. 29 sec. G.M.T., on Oct. 9. The record indicates that the epicentre lay about 70 or 80 miles off the coast in lat. 16° N., long. 101° W. Seven earthquakes from the same neighbourhood have been recorded at Kew this year, the shock of Oct. 9 being the most violent. According to a message published in the *Times* for Oct. 10, the shock caused some damage at Acapulco (90 miles from the centre), Oaxaco (230 miles), and Mexico city and Chalco (270 miles), and the total disturbed area cannot have been less than 350,000 square miles. An interesting point about this earthquake is the westerly migration of the origin since the great earthquake of June 16, the epicentre of that earthquake, according to the Kew bulletin, lying in lat. 16° N., long. 100° W., or about 65 miles to the east of the last epicentre.

The warming of passenger trains is a problem on which much thought has been expended by railway engineers. In making estimates of the running costs, the time required for the preliminary heating of the train before it starts has to be taken into account. At least half an hour has to be allowed for this preliminary heating. This necessitates increasing the working hours of the employees, which always cause difficulties. In large railway stations in Switzerland, according to the *Brown Boveri Review*, central heating plants are provided for heating the trains by steam. This method, however, is objectionable, as steam escaping from insecure couplings often makes disturbing noises and causes unpleasant vapours. To get over these difficulties, the Swiss Federal Railways have been making experiments on doing the preliminary heating electrically. The large station at Zurich has a transformer plant with eleven heating connexions and the auxiliary station has eight heating connexions. The current is taken directly from the 15,000 volt contact lines and transformed down to 1000 volts. In an extensive railway network, frequent short circuits causing excessive voltage drops are to be expected. A device is therefore provided which recloses the heating switch automatically once or several times after the switch has opened due to a sudden voltage drop. The plant at Zurich has now been in continuous operation since December 1927 and has given complete satisfaction.

After the formal business had been concluded at the annual meeting of the British Horological Institute on Oct. 10, Mr. B. T. Greening, who presided, presented to Sir Frank Dyson, the Astronomer Royal, the first gold medal awarded by the Institute. The medal is awarded for the greatest advance in the science of horology in each year or some achievement of merit beneficial to the science or practice of time measurement. Sir Frank Dyson has been Astronomer Royal since 1910, and has devoted particular attention to precision in time measurement. In presenting the Institute's medal in recognition of this and other work, the chairman referred to the Greenwich time-signals, to the inauguration of the six-dot seconds through the British Broadcasting Corporation, and last, but not least, to the initiation by Greenwich of the first official government service throwing a girdle round the earth in the form of the Rugby rhythmic transmissions, which are unique in character and unsurpassed for accuracy. Reference was also made to the adoption by the Astronomer Royal of a novel form of precision clock which had recovered for the British Empire the record for accuracy in time measurement. In the course of a short speech Sir Frank said that he had encouraged his colleagues

... with all possible accuracy: he regarded the presentation not only as a tribute to himself personally, but also to his co-workers at Greenwich and, particularly, Dr. Jackson and Mr. Bowyer.

IT is now stated that at the Second International Conference on Bituminous Coal to be held at Pittsburgh, U.S.A., under the auspices of the Carnegie Institute of Technology, on Nov. 19–24, more than a hundred speakers, representing twelve countries, are expected to be present. Major subjects of discussion will include coal preparation, pulverised fuel, gas production and purification, liquefaction and hydrogenation of coal, carbonisation and combustion, tars and ammonia. The chief purpose will be to present the results of recent studies that have to do with improved methods of utilisation and combustion of bituminous coal. The speakers expected include many with international reputations in their respective fields, and more than sixty of them will come from countries outside the United States. The British delegation, as anticipated, may include about fifteen prominent chemists and engineers, while Lord Melchett will also speak.

THE Report of the Fuel Research Board (Department of Scientific and Industrial Research) for the period ended Mar. 31, 1928, which has been issued (H.M. Stationery Office, 1928. Pp. 70. 1*s*. 3*d*. net), covers the activities of about two years. It shows that the survey of national coal resources—one of the original objects of the Fuel Research Department—is now in operation in coalfields producing 85 per cent of the British output. The work of standardising methods of sampling and analysing coal has been taken up by the British Engineering Standards Association with the view of reaching national and possibly international agreement. Several plants for the low temperature carbonisation of coal have been tested and reported on, while plant embodying the retort system developed at the Fuel Research Station and now being erected by the Gas Light and Coke Company, is expected to be in operation shortly. It is pointed out that low temperature carbonisation is important rather as a source of smokeless fuel than of liquid fuel, while its effect in creating useful employment is not negligible.

Low temperature carbonisation processes can scarcely be expected to render Great Britain self-supporting in the matter of liquid fuels. Hydrogenation when commercially feasible would be much more effective. The Report of the Fuel Research Board states that work on hydrogenation of coal is being continued on an intermediate scale, and the staff is studying the chemical changes during the process, development on commercial lines being now undertaken by Imperial Chemical Industries, Ltd. Great attention is being paid to the properties of coke for all purposes, especially for domestic use, here in collaboration with the Building Research Board. Briquetting, coal purification, internal combustion engines are dealt with, but the prospects of a large production of power alcohol in Britain have been shown to be unpromising. Reference is also made to work carried out with the financial assistance of the Board by workers in the universities and other institutions throughout the country. The report shows that the original objects of the establishment of the Board are being fulfilled in a large measure.

THE Irish Tourist Association has made arrangements with Mr. George Fletcher, until recently assistant secretary of the Department of Agriculture and Technical Instruction in Ireland, to deliver lectures on Ireland in various centres during the period Oct. 1–Mar. 31. Mr. Fletcher has a close personal knowledge of Ireland, extending over more than a quarter of a century, and is well known as a writer on Irish matters and as editor of five volumes on "Ireland and the Irish Provinces" (Cambridge University Press). The subjects of the present lectures are: (1) Ireland: its scenery and people; (2) the art and antiquarian treasures of Ireland; (3) the evolution of Irish scenery; (4) the economic and industrial resources of Ireland. The lectures will, if desired, be fully illustrated by lantern pictures, and, in addition, Mr. Fletcher can give short addresses to interested local organisations where this can be arranged. No charge will be made for the services of the lecturer, but all local expenses, such as provision of suitable lecture room, with optical lantern and operator, must be borne locally. Particulars of the lectures can be obtained from the Secretary, Irish Tourist Association, American Chambers, Lower O'Connell Street, Dublin.

THE courses of lectures arranged at the Royal Institution during November and December will commence with the Tyndall Lectures to be delivered by Prof. H. L. Callendar, who will give three lectures on co-aggregation versus continuity in the change of state from liquid to vapour, beginning on Tuesday, Oct. 30, at 5.15 P.M.; and on Tuesday, Nov. 20, Sir William Bragg delivers the first of four lectures on diamonds. On Thursday afternoons, beginning on Nov. 1, there will be lectures by Captain G. Pitt-Rivers on the clash of culture: (1) Race and culture; (2) culture-clash in a Maori village; (3) the Empire and the native problem; two by Dr. E. D. Adrian on the mechanism of the nerves, and two by Sir Richard Paget on human speech as (1) a method of expression by gesture, (2) a musical phenomenon. On Saturday afternoon, Nov. 3, at three o'clock, the Rev. T. E. R. Phillips will deliver the first of two lectures on recent observations and discoveries respecting the planets; on succeeding Saturdays there will be three lectures by Dr. W. G. Whittaker on (1 and 2) North Country folk music, (3) violin sonatas of William Young, with musical illustrations. The Juvenile Lectures this year, the one hundred and third course, will be delivered by Mr. Alexander Wood on sound waves and their uses: (1) Waves (Dec. 27); (2) signalling in air and water (Dec. 29); (3) notes and noises (Jan. 1); (4) how sounds are analysed (Jan. 3); (5) the ear and what it does (Jan. 5); (6) how sounds are recorded and reproduced (Jan. 8).

A RECENT issue of the *Chemisch Weekblad* contains a detailed account of the proceedings of the chemical section of the Sixth Congress of Czechoslovak Naturalists, Physicians, and Engineers, which was held in Prague from May 25–30. This congress, which is a continuation of the pre-War Czech scientific congresses, was a scientific celebration of the tenth anniversary of the Czechoslovak Republic and was attended by about 2300 members, including 400 foreign visitors, chiefly from Slavonic States such as Poland, Yugoslavia, Bulgaria, and Russia. The congress was under the patronage of President T. G. Masaryk, and its chairman was Prof. E. Votoček, the distinguished organic chemist from the Polytechnic High School at Prague. In the five sessions dealing with chemistry, 111 communications were presented from 98 authors. The foreign guests included Profs. W. P. Jorissen (Leyden), T. Miłobędzki (Poznań), St. Tołłoczko (Lwów), and G. Urbain (Paris). Summaries of all the communications were published in Czech and also in English or French; copies may be obtained from Prof. J. Heyrovský, Prague-II, Preslova ul. 1, who presided over the Chemical Section.

THE executive committee in charge of the centenary celebrations of the Faculty of Medicine in Cairo and the International Congress of Tropical Medicine and Hygiene has issued a circular giving details of the programme for the week Dec. 15–22, and the list of guests from all parts of the world who will then assemble in Cairo. The most significant ceremony will take place on Dec. 16, when, in the presence of King Fuad, the foundation stone of the new medical school and hospital will be laid. As the first serious study of ankylostomiasis and bilharziosis was begun in Cairo, it is fitting that the most prominent place in the comprehensive programme of the scientific proceedings should be occupied by discussions of these worldwide scourges. Arrangements have been made for a series of excursions in Egypt, Palestine, and Syria. The Tourist Development Association of Egypt has issued a beautifully illustrated guide entitled "Egypt and the Sudan," containing a series of articles by Prof. George A. Reisner and other well-known archæologists and authorities on Egyptian and Oriental subjects, ranging from the beginning of architecture and sculpture to the practice of aviation in Egypt and Mesopotamia, duck-shooting in the Delta, and the presentation of Shakespeare's plays in the Cairo theatre. Correspondence relating to the Congress should be addressed to the Congress Bureau, 1 Sharia Mazloum Pacha, Cairo.

THE Council of the Institute of Metals has just issued the new session's programme of the Institute and of its local sections in Birmingham, Glasgow, London, Newcastle-on-Tyne, Sheffield, and Swansea. An outstanding meeting is that planned for Mar. 6, when the 'coming-of-age' celebrations of the Institute will be held in London under the presidency of Dr. W. Rosenhain. Another interesting feature is the annual autumn meeting, which will be held in Düsseldorf in September. This is the first occasion that any British scientific society has held a meeting in Germany since 1914, and it is expected that the meeting will be largely attended by members from the continent as well as from the British Isles. The programmes of the six local sections of the Institute include 42 papers and meetings. Several of the papers will be discussed at joint sessions with other bodies, notably the Institution of Engineers and Shipbuilders in Scotland, the Institute of British Foundrymen, the Birmingham Metallurgical Society, and the Staffordshire Iron and Steel Institute. These joint meetings constitute an important new feature in the work of the local sections which were first developed by the Birmingham Local Section. The London Local Section has arranged a discussion on "Some Present-Day Metallurgical 'Tools' and Methods," the latter including the X-ray spectrometer, quantitative spectroscope analysis, high-magnification microscopy, the dilatometer, and the preparation of some unusual metallographic specimens. Short addresses by various experts on each of these subjects will be given. The North-East Coast Local Section strikes out a new line in planning an exhibition of metallurgical preparations and products. Membership of the Institute is now approaching 2000. Particulars of the meetings and invitations can be obtained from the secretary, Mr. G. Shaw Scott, 36 Victoria Street, London, S.W.1.

THE Right Hon. Earl Fitzwilliam has consented to act as president of the fortieth Congress and Health Exhibition of the Royal Sanitary Institute, to be held at Sheffield on July 13–20, 1929.

THE twenty-fifth anniversary of the foundation of the Faraday Society will be celebrated on Friday, Nov. 9, at a meeting at the Royal Institution, when Sir Oliver Lodge will deliver the first Spiers Memorial Lecture, on "Some Debatable Problems in Physics." The chair will be taken by Sir Robert Hadfield. The Lecture, it will be recalled, was established in memory of Mr. F. S. Spiers, one of the founders of the Faraday Society, and its secretary and editor until his death on May 21, 1926.

THE Lord President of the Council has appointed Sir David Milne-Watson and Mr. Robert Whyte Reid to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, in the place of members who have retired on the completion of their terms of office. Sir James Hopwood Jeans has been reappointed a member of the Advisory Council for a further period of one year.

THE presence of living micro-organisms in the centre of ancient rocks is claimed to have been demonstrated by Prof. Charles Lipman of the University of California (*Science*, Sept. 21, p. 272). He states that certain organisms of a strikingly different type from any usually associated with soils and rocks were cultivated from specimens of pre-Cambrian and Pliocene rocks after drastic sterilisation of the exterior and all precautions to avoid contamination. We shall await with interest the further detailed studies of the subject which are promised.

THE *New Coal Age* is a monthly periodical (price 6*d.*) published at 1 Buckingham Street, Strand, London, W.C., under the editorship of R. W. Johnson. It is described as a journal of low temperature carbonisation and the scientific treatment of coal. The first number contains open letters to Mr. Baldwin and British industrialists pleading for a national policy of coal carbonisation. There is also general and historical matter, and some account of a plant to be installed by Continuous Carbonisation, Ltd., at Erith. Mr. D. Brownlie contributes a survey of developments abroad, and there are a few short articles on steam-raising on land and sea.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant lecturer in physics and electrical engineering at the Municipal College of Technology, Belfast—The Principal, Municipal College of Technology, Belfast (Oct. 23). An assistant pathologist at St. Thomas's Hospital—The Secretary, St. Thomas's Hospital, S.E.1 (Oct. 29). An assistant bacteriologist in the department of pathology and bacteriology of the University of Sheffield—The Registrar, the University, Sheffield (Oct. 29). A junior lecturer in electrical engineering in the University of the Witwatersrand, Johannesburg—The Secretary to the High Commissioner for South Africa, Trafalgar Square, W.C.2 (Nov. 1). A woman lecturer in education in the Department of Education of the University of Bristol—The Secretary, The University, Bristol (Nov. 2). A research officer in the Civil Veterinary Department of the Government of Burma to carry out researches in connexion with the diseases of elephants, draught buffaloes, and other domestic animals in Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 31). A chief librarian of the University of Birmingham—The Secretary, The University, Birmingham. A chemistry master at the Sandown County Secondary School—The Director of Education, County Hall, Newport, Isle of Wight.

Our Astronomical Column.

COMETS.—Taylor's Comet of 1915 is now due at perihelion. Prof. G. van Biesbroeck and Mr. Chang, of the Yerkes Observatory, have computed the perturbations by Jupiter, which were very large, the distance between comet and planet in June 1925 being less than a quarter of a unit. They give the following elements and ephemeris (*Harvard Announcement Card*, No. 73) :

T 1928 Oct. 22·38 U.T.

$$\left.\begin{array}{ll} \omega & 355^\circ\ 31'{\cdot}8 \\ \Omega & 108\ \ 15'{\cdot}3 \\ i & 20\ \ 44'{\cdot}9 \end{array}\right\}\ 1928{\cdot}0$$

ϕ 29 10′·1

Period 6·7580 years

Ephemeris for 0^h U.T. :

	R.A.	N.Decl.	log *r*.	log Δ.
Oct. 16	$8^h\ 54^m\ 59^s$	14° 44′	0·263	0·281
24	9 13 18	14 44	0·263	0·264
Nov. 1	9 31 12	14 46	0·264	0·246
9	9 48 30	14 54	0·265	0·228

The magnitude may be about 13. It will be remembered that the comet divided into two portions in 1915, so both should be looked for.

Dr. Baade obtained a photograph of the comet 1927*i* (Schwassmann-Wachmann) at Bergedorf as follows: 1928 Sept. $21^d\ 0^h\ 52^m{\cdot}1$ U.T., R.A. (1928·0) $3^h\ 48^m\ 41^s$, N. Decl. 30° 31′, mag. 16·5.

It will be remembered that this comet has a remarkable orbit, which lies entirely between those of Jupiter and Saturn ; the new observation is seven months later than the previous ones, so will greatly strengthen the determination of the orbit. It appears, however, that the elements of Messrs. Berman and Whipple are not much in error, as the ephemeris by C. Vick, based upon them, represents the place within 4′.

THE PERIOD OF THE VARIABLE STAR TT HYDRÆ.—The variability of this star was discovered by Dr. H. E. Wood from Johannesburg photographs taken between March and May 1926. He found that it was of the Algol type, with a period of about 6·96 days. With the aid of Prof. E. Hertzsprung, who examined old Harvard Observatory plates, and found images of the star going back to 1894, it is now possible to deduce very accurate elements which are published in *Union Observatory Circ.*, No. 77. The period is 96·53401 days, with a probable error of 0·000008.

The range is from 7·5 mag. to 10·1 mag. ; the minimum is apparently quite flat for $\frac{1}{30}$ of the period, or nearly 6 hours, indicating total eclipse of the brighter component. Once a fairly exact period was found it was possible to improve it by considering photographs taken at the time of most rapid light-change.

The article affords a good example of the value of the Harvard storehouse of plates, and of the methods for using them to the best advantage.

THE COMPANION OF SIRIUS AND THE EINSTEIN SPECTRAL SHIFT.—Prof. W. S. Adams's investigation of the spectrum of the companion of Sirius was of such extreme difficulty, and led to such important conclusions both as to the Einstein shift and the high density of the star, that an independent verification of the result is welcome. This has now been obtained by Mr. J. H. Moore, using the 36-inch Lick reflector, and a one-prism spectrograph with a camera of 16 inches focal length (*Pubs. Astr. Soc. Pacific*, Aug. 1928). The investigation is based on four spectrograms obtained last February and March. The type of the companion's spectrum was studied. Its type is slightly later than that of Sirius ; it is classified as *A*5, possibly *A*3 or *A*4, but certainly not so late as *F*0, the value adopted by Eddington. One of the four results was excluded from the mean, as it was seriously affected by scattered light from Sirius ; the mean of the other three gives 24 km./sec. as the radial motion of the companion relatively to Sirius ; deducting 5 km./sec. for orbital motion, the remainder 19 km./sec. is in exact accord with Adams's result. No correction has been applied here for the superposed light of Sirius ; if corrections were applied according to Adams's formula the result would be increased to 21 km./sec., but the agreement is still good considering the difficulty of the research.

Research Items.

MARGIDUNUM.—Dr. Felix Oswald reviews the results of his excavations on the Roman site of Margidunum in a paper published in the *Transactions of the Thoroton Society*, vol. 31. Margidunum was situated on the Fosse Way, half-way between Leicester and Lincoln, and in the early days of Roman occupation was of considerable strategic importance. When, however, the frontier was pushed north, it ceased to be of value in this respect, and, being off the trade routes, it became merely a posting station. It revived under Constantine, when in the then flourishing condition of Britain it became a seat of much activity. At the close of the occupation it suffered no violent end but sank into decay. It was never occupied by the Saxons. Owing to the long period of its continuous occupation, its history, as revealed by excavation, affords numerous illustrations of changes in Roman practice and culture. The name is probably a Romanised form of a Celtic denomination meaning 'the plain of the king,' and the adjacent eminence on which Belvoir Castle is situated may have been a hill-fort of the king of the Coritani. Sporadic relics of prehistoric times have been found—flint arrow heads, polished axes, and bronze socketed celts. That the Roman occupation was early is indicated by the rhomboidal form of the first camp. It was protected by a wooden palisade and a system of trenches or ditches, six in number. In later times, when the Romans abandoned this system of defence for a stone rampart with a single ditch, the marshy ground of the early site was filled in with stone and rubbish and gravelled over. In the early days the soldiers may have lived in leather tents or in the underground cellars which have been found. After the burning of the camp by Boudicca in A.D. 61, stone barracks were erected. There are other signs of this consequence of the disastrous defeat of the Ninth Legion, then stationed at Lincoln, by the British queen. Moulded stones much calcined by fire were found in the ditch. These, it is conjectured, are parts of the stone gateways which gave access to the original camp within the wooden palisade.

SEX OF EELS.—Grassi's presumption that the so-called 'male' freshwater eels, less than 30 cm. in length, are not sexually defined has been experimentally confirmed by J. J. Tesch (*Jour. du Conseil Perm. Int. pour l'Exploration de la Mer*, vol. 3, No. 1, April 1928). The remarkable fact that as a rule males are to be found in estuaries and river-mouths, whereas females are most numerous in the upper reaches, has long attracted attention. Further, females outnumber the males wholesale in samples of the larger eels, though they are almost absent in those of smaller individuals. This cannot be explained altogether by the supposition that females grow more rapidly than males, thus telescoping the earlier stages. Tesch took a large number of small eels (20-25 cm.) from the Zuiderzee and kept them for three years in concrete tanks. A sample of these when first taken consisted entirely of 'males.' After a year there was no change, but after another two years, three in all, the survivors, twelve in number, were *all females*, with numerous ova developing in their ovaries. This experiment is being repeated on a larger scale. Further investigations on age determination confirm the fact that males do not become silver eels, that is, ready for the spawning migration, until their sixth year, and the vast majority not until their seventh or later, when they are 30-42 cm. in length. Female silver eels are not found less than about ten years old, and reach a much greater size.

RESEARCHES ON EARTHWORMS.—Three papers in the *Science Reports of the Tohôku Imperial University* (Fourth Series (Biology) Sendai, Japan, Vol. 3, No. 3, Fasc. 3, May 1928) deal with the biology and anatomy of Japanese earthworms. Mr. Takeo Imai's work describing the nervous system of *Perichæta megascolidioides* Goto and Hatai is valuable; the large size, toughness of body wall, and peculiar behaviour of this worm when stimulated making it an exceedingly good object for various researches; and as it represents the commonest genus of earthworms in Japan, knowledge of its anatomy is eminently desirable. Although the general scheme of the nervous system agrees with that of other earthworms which have been described, there are certain differences, especially in the number of cerebral nerve trunks arising from the cerebral ganglion which supply the prostomial region and buccal cavity. "The Effect of Inorganic Salts on Photic Orientation in *Allolobophora fœtida* (Sav.) (3). Nitrates," is described by Mr. Ekitaro Nomura and Mr. Shinryo Ohfuchi, who have previously dealt similarly with chlorides and sulphates in earlier work in this same journal (No. 2 and 3, Vol. 3). *Allolobophora fœtida* is also the subject of Mr. Sataro Kobyashi's paper on spectroscopic observations on porphyrin in the integument of this worm. The object of this research was to decide whether the pigment belongs to hæmoporphyrin, the conclusion being that it differs spectroscopically in certain important particulars.

FEEDING MECHANISM OF *CHIROCEPHALUS*.—Prof. H. Graham Cannon describes (*Trans. R. Soc. Edin.*, 55; 1928) the feeding mechanism of the fairy shrimp *Chirocephalus diaphanus*. This animal normally swims on its back and feeds on minute particles which it separates from water-currents produced by its trunk-limbs. Water is drawn into the mid-ventral space between the trunk-limbs mainly from in front and above, passes out laterally between the limbs and is swept backwards in two powerful lateral swimming currents. The rhythm of the limbs which produces the swimming stream and the food current is carefully described. The food-particles, drawn into the mid-ventral space by the suction produced during the forward stroke of the limbs, are carried towards the mouth and passed by the maxillules on to the mandibles and probably entangled by the secretion of the labral glands. The view that the phyllopodium represents the primitive crustacean limb is criticised, and it is suggested that a flat, biramous, paddle-like limb, such as occurs in the posterior trunk-segments of *Lepidocaris*, represents the constitution and arrangement of the primitive crustacean limb.

HUMUS-LIVING MILLIPEDES.—O. F. Cook and H. F. Loomis give an account (*Proc. U.S. Nat. Mus.*, vol. 72, Art. 18, 1928) of millipedes of the order Colobognatha from Arizona and California, with descriptions of six new genera. A special interest is claimed for millipedes of this order as examples of interrupted or residual distribution in widely separated regions which could not be reached by any method of transportation now at the disposal of these animals. The explanation of such facts of distribution is to be found in the vegetation and the surface conditions in former ages, which must have been very different from those of the present time. The Colobognatha are delicate, fragile, slow-moving millipedes, unable to burrow in the soil or to withstand surface exposure; the legs and other appendages are very short and unspecialised, and the mouth parts rudimentary. The outstanding requirements for these humus animals is a continuous

supply of moisture. A study of the distribution of the humus fauna may throw light on the natural conditions in the south-western area of the United States before the period of human activity, for there can be little doubt that the surface conditions have been greatly changed during the human period.

A BACTERIAL DISEASE OF PINEAPPLES.—F. B. Serrano describes a brown-rot of pineapples in the *Philippine Journal of Science*, vol. 36, July 1928. On the basis of inoculation experiments, he decides that the causal organism is a primuline yellow bacterium, a new species *Erwinia ananas*, which is fully described with particulars of its behaviour in culture. Whilst the disease does relatively little damage to the native pines, 54 per cent of the fruits of the 'Smooth Cayenne' variety examined were attacked, and one-third of these were a total loss. As is so often the case with bacterial diseases, the flowering stage is the susceptible stage. The stigma, with its sugary surface ready for the pollen, provides an inviting opportunity for the pathogen, which also enters by natural lesions in the placenta and near the base of the stamens. As the fruit matures, inoculation experiments show that the tissues become more resistant to the organism, a fact which explains the important observation of the author that the disease does not seem to make headway upon fruits in storage.

EARTHQUAKES DURING 1918–24.—The catalogue of earthquakes for the seven years 1918–24 which has been prepared for the British Association by Prof. H. H. Turner, will be greatly valued by seismologists ("Catalogue of Earthquakes 1918–24: being a Digest of the International Seismological Survey (1918–24)". Pp. 64. London: British Association, 1928. 2*s*.). Based on the *International Seismological Summaries*, the catalogue gives for every important earthquake its date in Greenwich time, the position of its epicentre, the number of stations at which it was recorded, thus suggesting a rough measure of its intensity, and the previous dates at which the same origin was in action. Earthquakes in which the preliminary wave *P* was observed at distances of at least 80° from the epicentre are indicated, as well as those earthquakes with focal depths that differ much from the normal. As many as 29 earthquakes appear to have a focal depth of 0·05 or more of the earth's radius below the normal depth, which is taken to be about 0·008 of the radius or 30 miles. In two earthquakes the depth is given as 0·08 radius below the normal. It is worthy of notice that no day in the whole seven years is without a record, though on some days an earthquake was registered at only one or a few places.

GEOLOGY OF ZANZIBAR.—During the years 1925–26, Mr. G. M. Stockley made a detailed geological investigation of Zanzibar and Pemba, and his results are now handsomely published by the Government of Zanzibar (*Report on the Geology of the Zanzibar Protectorate*, March 1928, price 12*s*. 6*d*.). It is shown that the present East African coastline was determined in Neogene time, Pemba being separated from the mainland towards the end of the Miocene as a result of rift-faulting. This severance is reflected in the difference between the living fauna of Pemba and those of Zanzibar and the mainland. Zanzibar became individualised very much later. Originally a sandbank fringed with corals, the advance of the Azanian Sea in early Pleistocene times converted it into a group of small islands. Retreat of the sea followed by recent encroachment produced the present outlines. Pemba has also been affected in recent times by a relative rise of sea-level. The Tertiary and Recent deposits are described in adequate detail, and a particularly valuable chapter deals with the correlation of the Indo-Pacific Neogene. Water supply and other economic questions are naturally discussed fully, since they were among the primary considerations which led up to Mr. Stockley's appointment.

FLOW OF WATER THROUGH THE STRAITS OF DOVER.—Dr. J. N. Carruthers has written a memoir entitled "The Flow of Water through the Straits of Dover as gauged by Continuous Current Meter Observations at the Varne Lightvessel," Pt. 1 (Fishery Investigations Series 2, Vol. 11, No. 1. London: H.M. Stationery Office, 1928), dealing with the mechanism and the results obtained with a drift indicator which he has designed on the principle of the Ekman current meter, but which can be left working for 3 days or more, even in the roughest weather. The indicator is well adapted for the heavy service of obtaining continuous records, one instrument having been worked continuously for a year by the personnel of a light vessel. The run of the north-east going tidal stream through the Straits of Dover was usually found to exceed the return south-west going stream. During the course of a lunar day the excess flow amounted on an average to 2·7 miles, from the Channel into the North Sea. At times this was greatly exceeded, the extreme being 16·8 miles, associated with strong south-westerly winds driving the water up the English Channel, southerly winds in the North Sea and spring tides. In this case each 'flood' or north-east going tidal stream ran about 11 miles while the ebb stream only ran about 2¼ miles. At other times the ebb or south-west going tidal streams exceed the 'flood' or north-east going streams, resulting in an over-all flow of water, or residual current, from the North Sea into the English Channel. The extreme so far recorded of this reversal of the usual current is 11·9 miles per lunar day from the North Sea into the Channel. These reversals are brought about by the tractive force of north-easterly winds in the Channel, usually in conjunction with northerly or north-westerly winds over the North Sea which tend to pile up the water towards the south. The author has estimated from records extending over a year that enough water comes through the Straits of Dover annually from the English Channel to form a layer 13¾ feet deep over the whole superficial area of the North Sea.

FIXATION OF SAND DUNES.—Many countries are faced with the problem of controlling and reclaiming sandy wastes in order to check destruction of arable land. Some account of the successful work in Cyprus is given in the *Bulletin of the Imperial Institute* (vol. 26, No. 3) by Dr. A. H. Unwin. The areas of sandy waste in Cyprus are small—the largest is a little more than five square miles—and the meteorological conditions are favourable. Most of the year is moist, but August–September and December–January are dry periods. The sand consists mainly of silica, but there are sufficient mineral salts to allow a fair growth of trees. Water is provided from wells and is raised by an air motor to a tank from which irrigation channels lead. When the channels are ready, the seedlings are planted, and when the area is completely planted the air motor is moved to another site. In some cases ploughing and drilling is a sufficient preparation of the ground, but for at least the first five seasons the seedlings must be watered in the dry seasons by carts or gravitation channels. Under these conditions growth is quick. The wattle was mainly used, but other useful trees are the Aleppo and stone pines and the cypress. Several other trees, including the eucalyptus, carob, olive, false acacia, and juniper, have been tried.

OSCILLATIONS IN IONISED GASES.—During the last few years, several instances have been reported of the occurrence of electrical oscillations the origin of which could not be traced with certainty, in thermionic and other similar devices. These have been particularly noticeable in discharge tubes containing gas, which often possess an intrinsic natural period which is independent of the circuit connected to them. Dr. I. Langmuir has, however, now published in the August issue of the *Proceedings of the National Academy of Sciences* a theoretical analysis of the possible modes of vibration of what he refers to as a *plasma*, a highly ionised gaseous medium at low pressure which contains, when undisturbed, equal numbers of positive ions and of electrons, and appears to have accounted for the majority of these hitherto unexplained observations. Waves in the component electron gas should be of high frequency, with a zero group velocity, and so be incapable of transmitting energy; these appear to be identical with some oscillations of small amplitude first noticed at Eindhoven in discharges from a hot filament through a gas, and since obtained at Schenectady with a frequency as high as 10^9 cycles per second. Similar vibrations of lower frequency should theoretically also occur in a beam of electrons, and have in fact been detected, whilst the electrical analogue of sound waves has been found in a vibration of the heavier positive ions, and tentatively identified with the type of ionic oscillations which is supposed to be associated with moving striations. The question of amplitudes still presents some difficulties, but on the whole the agreement between theory and experiment is good, and may well lead to advances in the technical use of 'soft' thermionic valves and of gas-filled rectifiers.

THE RAMAN OPTICAL EFFECT.—The issue of the *Zeitschrift für Physik* for Sept. 19 contains several papers upon the changes in wave-length which occur when light is scattered by certain transparent media, one from Moscow, by G. Landsberg and L. Mandelstam, being of special interest in that it appears that a positive result had already been obtained with quartz before the appearance of Prof. Raman and K. S. Krishnan's first note on the subject in NATURE last March. The other researches which are described by C. E. Bleeker in Utrecht, and by Prof. Pringsheim and B. Rosen in Berlin, were undertaken primarily to test the reproducibility of the Indian results, and only the German workers have reported upon their observations in detail. They find that the fundamental vibration of the C-H group at 3·3 μ can be superposed on the incident light by all the compounds which they have used that possess it, but also that although all the modified scattered rays from organic liquids can be referred to known infra-red frequencies of these liquids, not all of the infra-red vibrations give rise to Raman lines. In this connexion they point out in a footnote that many of the conclusions that have been drawn from measurements in the infra-red are quite unwarranted, because of the small accuracy that can be attained in the spectroscopy of this region. Two further results that they have obtained are also somewhat unexpected, namely, that the light scattered from fused silica shows no trace of the strong satellites produced by the action of crystalline quartz, and that the Raman spectrum of silicon tetrachloride is very weak and quite unlike the well-developed spectrum of carbon tetrachloride. It is noticeable that all three groups of investigators are agreed that it is important to measure both the position and the intensity of the Raman satellites.

RADIO TRANSMISSION AND SOLAR ECLIPSE EFFECTS.—Advantage was taken by the Radio Research Board of the opportunity provided by the solar eclipse of June 29, 1927, to investigate the influence of the eclipse on radio transmission. The experimental results have now been published by the Department of Scientific and Industrial Research (Special Radio Report, No. 7. London: H.M.S.O.). As exact quantitative results were desired, the experiments were limited to long waves the wave-length of which was about 13,000 metres and medium waves of about 400 metres. The observations show that the eclipse produced a definite effect on the properties of the ionised layer which deflects waves back to the ground. A striking effect was the large increase in the intensity of the down-coming ray. This was detected at both near and distant receiving stations. This effect is probably due to two causes: first, the increase in the height of the stratum responsible for bending the ray back to the earth; and secondly, the rapid removal of ionisation in the lower layers consequent on the removal of the solar ionising agents. The increase in the height of the stratum was so large that it could be detected without difficulty. The more southerly of the receiving stations experienced the maximum eclipse influence a little earlier than the northern stations. It is curious that the eclipse effects seem to have lasted only for periods of from 20 to 50 minutes, although the total time taken for the moon's shadow to pass across the sun was nearly two hours. This shows that quite an appreciable fraction of the sun's radiation can be cut off before the effect can be detected by ordinary radio methods. It is worth mentioning that the morning after the eclipse was exceptional, as night-time conditions persisted for an exceptionally long time after sunrise. The direction-finding observations carried out during the eclipse gave results which may be ascribed to changes in the effective height and reflection coefficient of the ionised layer.

CRACKING HYDROCARBONS IN THE PRESENCE OF HYDROGEN.—The North British Association of Gas Managers arranges annually a lecture in memory of William Young, prominent at one time in the coal gas industry and a pioneer in the distillation of oil. This year the lecture was given in Edinburgh by Mr. E. V. Evans, joint manager of the South Metropolitan Gas Company, who discussed what might be described as Young's discovery of the secret of carbonisation, namely, the carefully controlled cracking of hydrocarbons in the presence of hydrogen. Young had a remarkable intuition for the essentials of the problem, but was hampered by the necessity for evaluating his products according to their illuminating value. Mr. Evans stated that it has been found possible to bring into colloidal dispersion 90 per cent of a coal. The results of a special method of distilling coal in the laboratory were mentioned, whereby a primary tar, equivalent to 50 therms per ton of coal, was obtained, together with 25 therms of very rich gas. By heating the coke further to 1000°, 35 therms of gas could be obtained, or in all 110 therms in the volatile products—an unusually high result, not however to be anticipated in large-scale practice. The action of hydrogen in preserving from decomposition gaseous hydrocarbons is indicated by results of distilling low temperature primary tar at 800° in a stream of water gas. By this means as much as 106 therms of gas of calorific value 500 B.T.U. were obtained per ton of coal carbonised, together with a normal yield of low temperature coke and high temperature tar. This suggests a way in which low temperature processes might be fitted into the town's gas industry. The experiments emphasise the need for maintaining an adequate proportion of hydrogen during carbonisation, a need which Young himself realised many years ago.

Sheffield Laboratories for Safety in Mines Research.

By H. F. COWARD.

THE special dangers of the coal-miner's work have always aroused sympathy from the public, who have been generous in helping the families of miners killed in great colliery disasters. Preventive measures to avoid these dangers have been based on the occasional assistance of students of natural science, as when Humphry Davy invented a safety lamp, and on the continuous efforts of mining engineers. The methods of experimental science were not applied systematically until about twenty years ago, when the Mining Association of Great Britain—a body of colliery owners—set up a full-scale gallery at Altofts, in Yorkshire, to demonstrate the explosibility of a cloud of coal dust and to test the efficacy of stone dust as a means of preventing coal-dust explosions. The success achieved led the Home Office to build a more elaborate station at Eskmeals, on the Cumberland coast, for the experimental study of dust and gas explosions with the view of the development of means for preventing such disasters underground. The War brought this work almost to an end, but it was revived by the Miners' Welfare Fund Committee, which has enabled the Safety in Mines Research Board to build a large-scale experimental station near Buxton and laboratories in Sheffield.

On Thursday, Oct. 11, the Sheffield laboratories were formally opened by the Prime Minister, who made a tour of them, accompanied by Mrs. Baldwin, and witnessed a number of experiments. In his address, Mr. Baldwin said that he had been assured that the mines of Great Britain to-day are the safest in the world, and asserted that "they have got to be a great deal safer—both our mines, and mines throughout the world." He met an American research worker in the new laboratories. "There is already with America an interchange of personnel and information, similar arrangements have been concluded with France, and preliminary inquiries are being made as to the possibility of extending this system to other countries. . . . There may yet come a day when the great mining industry may be as safe, as far as danger to life and limb is concerned, as any industry on the surface of the earth."

The valediction of Mr. Herbert Smith, president of the Miners' Federation, was equally plain: "Compensation can't put limbs on or give life back. . . . When the miners lost about 100 per month through fatal accidents, when 400 a month were lamed seriously, and when about 16,000 played more than 3 days a week, they were anxious that research should go on . . .," he would say, "Go on with your good work and God bless you."

Other speakers at the ceremony were Commodore King, Secretary for Mines (in the chair); Lord Chelmsford, chairman of the Miners' Welfare Committee; Mr. Evan Williams, president of the Mining Association of Great Britain; and Sir Edward Troup, chairman of the Safety in Mines Research Board.

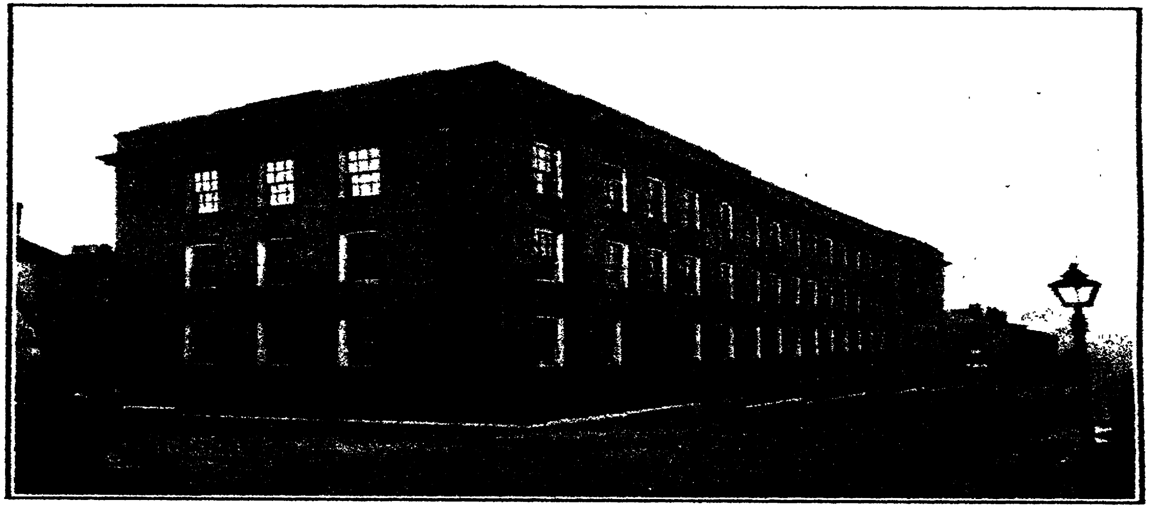

FIG. 1.—New laboratories of the Safety in Mines Research Board at Sheffield.

The new building (Fig. 1) is adjacent to the Department of Applied Science of the University of Sheffield, thereby securing for the staff close contact with the varied activities of a university. It has four floors and a basement, and the construction is such that two more floors can be added if required. As arranged at present, most of the twenty-four laboratories are small, and only adequate to house one investigator in each. Their size is, however, adjustable; for the partitions are light and can readily be removed if it becomes desirable to form larger rooms. The fittings and services have also been designed so as to enable quick and economical readjustment to meet the changing needs of research.

A portion of the new building has been allocated to the Fuel Research Board for use by the South Yorkshire committee for the survey of the national coal resources. The work of the investigators on the composition and properties of coal is closely allied with one part of the Board's work, and the association will be of mutual benefit.

The new laboratories, as well as the large-scale station at Buxton, are under the direction of Prof. R. V. Wheeler, who has been responsible for the scientific direction of such work in the twenty years since its inception at Altofts, by the Mining Association of Great Britain, under the general direction of Sir William Garforth.

RESEARCH IN PROGRESS IN THE NEW LABORATORIES.

Coal-Dust Explosions.—The experiments at Eskmeals proved that when sufficient incombustible matter is mixed with coal dust, an explosion of a cloud of the mixture is impossible. What research and experience recommended as the best practice was, in 1920, embodied in coal-mining regulations, and the happy result has been that no serious coal-dust

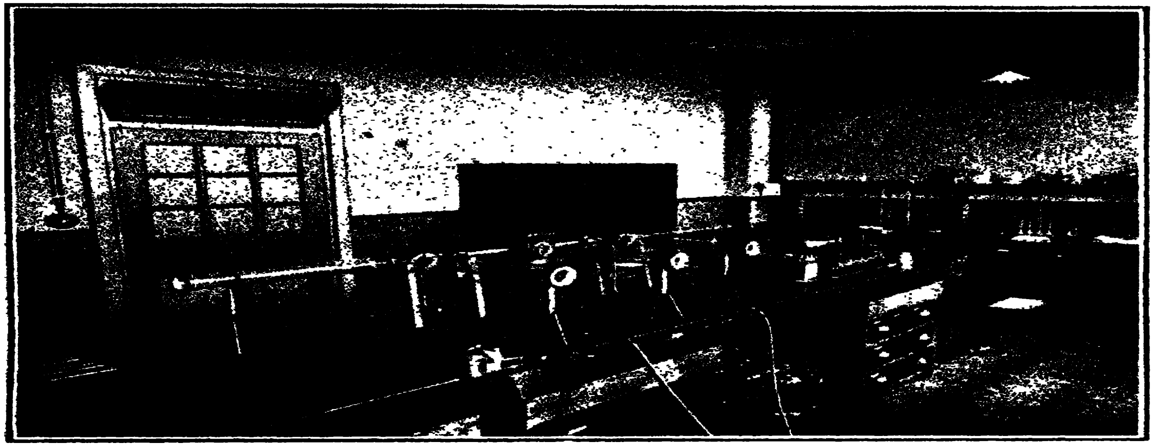

FIG. 2.—A laboratory fitted for flame research. Apparatus for observing the projection of flame in branched galleries; glass and metal tubes represent galleries which may be shut off at desired points by sliding partitions.

explosion has yet occurred in Great Britain in a pit treated with the required amount of stone dust.

The outstanding question to be answered is, whether the means now used to prevent coal-dust explosions always give adequate safety, and, if not, what improvements are possible. Different samples of coal dust differ greatly in explosibility, according to their physical state and chemical composition. One line of research is therefore planned to determine the effect of fineness on explosibility, another to compare the explosibility of a series of different coals ground to a powder which, so far as can be determined, is of the same average fineness for all. To save the time and cost of much of the large-scale experimentation which might be conducted for these objects, laboratory methods are being examined and have proved, so far, to give results parallel to those obtained in the full-scale galleries at Buxton. Both laboratory and field experiments on dust explosions, however, are empirical; a concentrated effort is therefore in progress to determine the composition of coal, not only for the sake of measures for preventing coal-dust explosions, but also for controlling the self-heating of coal in the wastes and in crushed pillars of coal in the mine.

Spontaneous Combustion of Coal.—Many mining engineers have experienced the difficult and dangerous task of fighting underground fires which have originated in the spontaneous combustion of some part of the coal substance. Experience has shown that certain seams are more liable to fires than others, and that some methods of mining lead to much less frequent fires than others. The experimental study of the spontaneous combustion of coal is a laboratory supplement to the engineer's observations underground.

Of the four macroscopic constituents of coal, namely, vitrain, clarain, durain, and fusain, the last named is the least readily oxidised and would therefore appear to contribute least to spontaneous heating. It is, however, the most porous and friable constituent, and therefore permits air to diffuse to the more oxidisable parts when a mass of coal is crushed. The function of pyrites is not yet fully understood, but its oxidation produces crystalline products of greater volume than the pyrites from which they were formed, and thus breaks up the mass to make way for the entrance of air.

The most readily oxidisable ingredient of coal has proved to be the ulmin fraction, which forms the major part of a vitrain and a clarain and a high proportion of a durain. The ulmin fraction is, however, not of constant composition, and variations in the oxidisability of coal are largely attributable to variations in the composition of the ulmins present.

Firedamp Explosions.—In the early days of coal-mining the danger of firedamp was met by the hazardous method of igniting the gas before it had accumulated in formidable amounts. This primitive procedure has long been superseded by improved ventilation designed to keep the amount of firedamp everywhere below the explosive limit, and by safety lamps designed in such a manner that they will not pass flame into the air in the event of the atmosphere becoming abnormally charged with firedamp. These precautions have enormously reduced the danger, but explosions still occur, sometimes with fatal results.

Research on firedamp explosions is directed towards discovering the conditions of ignition of firedamp and the mode of propagation of flame in mixtures of firedamp and air, so that suitable measures can be taken to avoid ignition underground and to prevent the spread of flame. Mining equipment, such as lamp

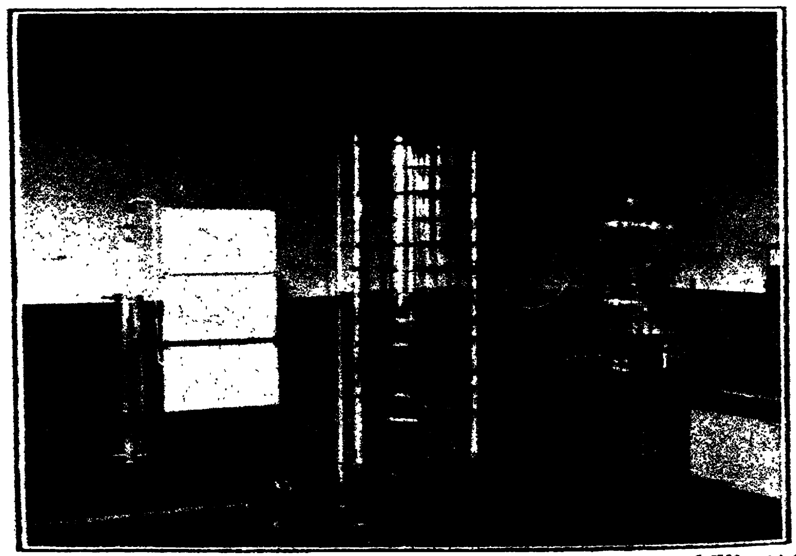

FIG. 3.—Apparatus for determining the limits of inflammability of gas mixtures. The narrow tube on the left is used for long series of experiments, and the applicability of the results to practical conditions is tested by the larger tube in the centre.

switches, and motors, are fitted with the safety devices suggested by research, and are tested in explosive atmospheres composed of firedamp and air in the proportions which give the most stringent test in the circumstances. For underground signalling by bells and telephones, the design of electric circuits has been so improved as to render the spark at break unable to ignite firedamp.

An extensive investigation of the danger of friction sparks from picks and coal cutters, and of electric sparks due to the spontaneous generation of electricity in a cloud of coal dust, is approaching completion.

Electrical Researches.—Apart from the investigations named above, the chief object of the electrical researches in the new laboratories will be to improve the safety of the electrical equipment necessary for increased illumination of the mine; for better illumination will not only enable the collier to avoid many accidents, but also will, it is believed, prevent the eye disease called miners' nystagmus.

Mining Explosives.—The official safety test for mining explosives was designed to be more severe than the conditions of the pit, but explosives which have passed the test have proved not to be safe in all circumstances. It seems impossible, at the moment, to propose any improvement on the test, for want of exact knowledge of the mode of ignition of gas by an explosive. The subject is under investigation by the Board, but the work has been mainly transferred to the Buxton station.

Safety Lamps.—Flame safety lamps have been studied in detail during recent years, and much improved illumination obtained by suitable modifications in design and suitable blendings of lamp oils. The results of these researches are in the hands of manufacturers, and experimental lamps are receiving trial underground.

Mine-Rescue Apparatus.—Self-contained breathing apparatus provides a supply of oxygen independent of the atmosphere, and is necessarily somewhat heavy and cumbrous. It may frequently happen that a suitable gas mask could be substituted, and attempts are being made to produce one which contains sufficient absorbents to remove all noxious gases, including carbon monoxide, and yet not to offer so much resistance to the passage of air that the wearer is hampered. A study of carbon monoxide estimators, and the construction of a portable oxygen estimator, are also contemplated.

The University of Leeds.

EXTENSION OF THE TEXTILE INDUSTRIES DEPARTMENT.

ON Thursday, Oct. 12, the Master of the Worshipful Company of Clothworkers of the City of London opened the new extension of the Clothworkers' Departments of the University of Leeds, the buildings of which have cost approximately £12,000, and the equipment, largely provided by donors in the textile industry, another £10,000. The extension has been designed to facilitate (1) the installation of an experimental wool plant covering all the processes for the woollen and worsted industries; (2) the extension of museum and laboratory accommodation to fulfil the requirements of a much larger number of post-graduate and degree students attending the department; and (3) to provide additional accommodation for the Silk Research Association which is housed within the University precincts.

It is fifty-four years since the Clothworkers' Company gave the first donation which enabled the Textile Industries Department to be installed alongside the Science Departments in the then Yorkshire College of Science. Largely owing to the traditional character of the wool industries and the complexity of the wool fibre and wool processes, the bearings of science upon the technology of the subject have not yet been completely realised, but an additional grant from the Clothworkers' Company of £4000 a year has made it possible to appoint, within the Department of Textile Industries, a science staff which, working along with the technological staff, is already showing promise of that association between science and technology which was the primary object of the Clothworkers' Company.

The complete equipments in the woollen and worsted manufacturing processes will enable the technological staff to define clearly many of the fundamental problems of the industry which in normal practice are hidden owing to a conglomeration of varying factors; and then, with the more refined 'tools' now available, the scientific worker is at hand either to solve the problems in question or to suggest the scientific tools which will help the technologist towards more perfect methods of manufacturing.

At the opening ceremony the Master was supported by a large gathering of representatives from the whole of the woollen and worsted industries and by other supporters of university developments in Yorkshire. The Pro-Chancellor of the University of Leeds, in introducing the Master, gave a history of the association of the Clothworkers with the University, which showed that grants of £100,000 for accommodation and equipment and £165,000 for maintenance had already been made, and that in addition to these a grant of £4000 a year had been raised to £7000 a year.

The Master, in declaring the buildings open, spoke of the intense interest the Clothworkers' Company takes in the extension of their departments of the University, and expressed his appreciation that the generosity of the Company has met with such a hearty response from the machine makers of Yorkshire and elsewhere. He congratulated the University on the progress it is making, and hoped that the present scheme would fulfil the anticipations of its promoters. The Vice-Chancellor, Dr. J. B. Baillie, and the chairman of the Advisory Committee, Mr. A. Michael Lupton, thanked the Clothworkers for their munificence, and the latter, in seconding the vote of thanks, emphasised the large amount of graduate and post-graduate work which is now being undertaken in these departments. Prof. A. F. Barker, on behalf of the staffs of the departments, and Mr. George Blackburn, on behalf of the past and present students of the departments, also supported the vote of thanks. The architect, Mr. Waterhouse, presented the Master with a key of the building, and the guests then made a tour of inspection.

In the equipment it is interesting to note the comprehensive display of such things as electric driving and lighting, air conditioning, floors and other matters appertaining to recent developments in factory construction and running. In other respects the equipments are representative of the latest practice, and almost without exception the firms involved have agreed to keep this equipment thoroughly up-to-date. Thus, not only will the equipment be used for teaching purposes, but also for experimental purposes on lines which will make a very strong appeal to those who are endeavouring to keep the textile industries of Great Britain well ahead in all manufacturing processes.

The Sixth Congress of Russian Physicists.

THE Russian Physical Society usually meets in one of the larger university towns, but this year a new departure was made, and in order to visit some of the more remote universities the congress became itinerant, in much the same way as is done by the British Association when it visits the Dominions. A number of foreign physicists were invited to become the guests of the society, and those who were fortunate enough to be able to do so were treated with the most generous hospitality. We have undoubtedly had as interesting a journey as we are ever likely to make.

The meeting began on Aug. 5 in Moscow under the presidency of Prof. Ioffe, of Leningrad. Here most of the papers were read, but there was no time for the Russian papers to be translated, and so those of the visitors who could not understand the language had plenty of opportunity for seeing the sights. Apart from the monuments and museums, we were shown a number of scientific institutions, among them the Biophysical Institute of Prof. Lazarev, where experiments over a most unusually wide field are being carried on. From Moscow we went to Nijni-Novgorod, where the great fair was in progress, though rather fallen from its former importance, and after a day there, including a meeting at the University, we took ship on the Volga. A special boat had been chartered, and this provided a great opportunity for the informal discussion of physical questions. It also made it possible to stop at any places of interest on the river, or when the weather turned hot to see the beautiful sight of two hundred physicists simultaneously enjoying a bathe.

We were most hospitably entertained by the University at Kazan, a beautiful city and the capital of the Tartar Republic, and we shall always think of Kazan as the culminating point of the whole tour. From there we moved on to Saratov, where the closing session was held on Aug. 15. Though this was the formal end of the congress, a continuation had been arranged in which many of the Russians and nearly all the visitors took part. We went on down the Volga to Stalingrad (formerly Tsaritsin) and then took train across the steppes to the Caucasus. From Vladikavkas we were carried in motors over the wonderful Georgian Road to Tiflis, where we were again entertained by the University. There the party broke up, most returning by various ways to Moscow, but a few of us found a ship going from Batum to Constantinople, and so returned by the Mediterranean.

For one who knows no Russian it is not possible to give a detailed account of the subjects of the papers, but physics certainly appear to be in a flourishing condition in Russia. Perhaps the most interesting work is that of Prof. Ioffe on the reflection of electrons—including an unsuccessful attempt to detect polarisation—and that of Profs. Mandelstamm and Landsberger. The latter described how they had independently discovered Raman's phenomenon, the scattering of light with changed frequency. This was predicted some years ago by the dispersion theory of Kramers (and still earlier by Smekal), and the verification is made by scattering the light from a solid or liquid and observing the change of frequency. This change is a measure of the wave-lengths of the infrared absorption of the scattering material, and so, apart from its direct interest, the phenomenon promises to be important for the spectroscopy of solids. In addition to the Russian papers, lectures were given by the visitors on various subjects; among them may be mentioned Prof. Ladenburg's verification of the 'negative dispersion,' also predicted by Kramers (see NATURE, Sept. 22, p. 438).

The general condition of Russian scientific workers seems to be more favourable than it was reported to be a few years ago. Their labours are very directly encouraged under the present regime, and, apart from the general impoverishment of the country, their chief hardship appears to be a sense of isolation due to the great difficulty they have in visiting other countries. Their guests will certainly all try to mitigate this difficulty in return for such a delightful tour.

C. G. DARWIN.

Research in Aeronautics.[1]

THE keynote of the policy of the Aeronautical Research Committee during the year 1927–28 appears to have been a recognition of the importance of close co-operation with the aircraft industry and the Services on one hand, coupled, on the other hand, with a consistently scientific attitude to test and research in the problems associated with these two branches. The numerous advances recorded and the high quality of the experimental work are a full justification of this policy.

The general progress in Great Britain resulting from research is exemplified in the performance of the British seaplanes competing for the Schneider Trophy. The immediate results are of course attributable to the designers of the machines and engineers, and to the splendid piloting by the R.A.F. officers, but a great deal of preliminary ground work was covered by close co-operation between the individual designers and the trained research staff at the National Physical Laboratory. Several models of each racing type were tested in the duplex tunnel at the N.P.L. in the endeavour to obtain results at the highest possible Reynolds' number, that is, as close to full scale conditions as possible, and the conclusions arrived at, after consultations between the designers and the N.P.L. staff, led to definite improvements. The Committee quite rightly stresses the importance of close co-operation between the designer and the actual research worker, as a vital factor in progress of this nature.

The part played by joint action of a similar kind is exemplified by the development of mechanisms for avoidance of control failure during stalling. The Committee has now spent some considerable time in a close study of the forces operating during the stall, and of the actual motion of the aeroplane in that condition, in the hope of preventing the serious type of accident which frequently follows an inadvertent stall. This hope has been fulfilled, and out of the original slot system there have developed several methods for reducing this danger. In particular, the use of a slot which automatically closes at low wing incidences, and so avoids the loss of performance due to an open slot, has greatly assisted this development. Meanwhile, various methods of using slots at the wing tips are being extensively tried in the Services and upon civil aeroplanes.

Valuable work is also recorded on the problem of wing flutter; the aerodynamic and structural factors

[1] Aeronautical Research Committee. Report for the Year 1927–28. Pp. 63. (London: H.M. Stationery Office, 1928.) 2s. net.

that originate it have been analysed, and studied experimentally on models, while modifications in design have been suggested with the view of its reduction, if not actual elimination.

So far as the power unit is concerned, the Committee records many important advances. Distinct progress has been made in the determination of the torsional vibrations of crank shafts in a form suitable for design routine, and there is a first indication that a critical speed lower than the normal running speed may safely be allowed. The question of compression-ignition engines has been examined. The advantages offered by an engine of this type are substantial: they include such features as the diminution of fire risk by use of a fuel of high flash-point; a fuel consumption possibly lower than that of a petrol engine; a cheap fuel; and a diminution of the heat that must be dissipated by the cooling system. On the other hand, there is the disadvantage of high maximum pressure and a greater weight per engine h.p. Starting difficulties are also experienced, but it is anticipated that these may be overcome.

Close co-operation with the Services is evidenced by the fact that measurements are being made of the fuel consumption in Service squadrons, and these indicate very wide variation as between one engine and another in the same flight.

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The Sixth Congress of Russian Physicists.

THE Russian Physical Society usually meets in one of the larger university towns, but this year a new departure was made, and in order to visit some of the more remote universities the congress became itinerant, in much the same way as is done by the British Association when it visits the Dominions. A number of foreign physicists were invited to become the guests of the society, and those who were fortunate enough to be able to do so were treated with the most generous hospitality. We have undoubtedly had as interesting a journey as we are ever likely to make.

The meeting began on Aug. 5 in Moscow under the presidency of Prof. Ioffe, of Leningrad. Here most of the papers were read, but there was no time for the Russian papers to be translated, and so those of the visitors who could not understand the language had plenty of opportunity for seeing the sights. Apart from the monuments and museums, we were shown a number of scientific institutions, among them the Biophysical Institute of Prof. Lazarev, where experiments over a most unusually wide field are being carried on. From Moscow we went to Nijni-Novgorod, where the great fair was in progress, though rather fallen from its former importance, and after a day there, including a meeting at the University, we took ship on the Volga. A special boat had been chartered, and this provided a great opportunity for the informal discussion of physical questions. It also made it possible to stop at any places of interest on the river, or when the weather turned hot to see the beautiful sight of two hundred physicists simultaneously enjoying a bathe.

We were most hospitably entertained by the University at Kazan, a beautiful city and the capital of the Tartar Republic, and we shall always think of Kazan as the culminating point of the whole tour. From there we moved on to Saratov, where the closing session was held on Aug. 15. Though this was the formal end of the congress, a continuation had been arranged in which many of the Russians and nearly all the visitors took part. We went on down the Volga to Stalingrad (formerly Tsaritsin) and then took train across the steppes to the Caucasus. From Vladikavkas we were carried in motors over the wonderful Georgian Road to Tiflis, where we were again entertained by the University. There the party broke up, most returning by various ways to Moscow, but a few of us found a ship going from Batum to Constantinople, and so returned by the Mediterranean.

For one who knows no Russian it is not possible to give a detailed account of the subjects of the papers, but physics certainly appear to be in a flourishing condition in Russia. Perhaps the most interesting work is that of Prof. Ioffe on the reflection of electrons —including an unsuccessful attempt to detect polarisation— and that of Profs. Mandelstamm and Landsberger. The latter described how they had independently discovered Raman's phenomenon, the scattering of light with changed frequency. This was predicted some years ago by the dispersion theory of Kramers (and still earlier by Smekal), and the verification is made by scattering the light from a solid or liquid and observing the change of frequency. This change is a measure of the wave-lengths of the infra-red absorption of the scattering material, and so, apart from its direct interest, the phenomenon promises to be important for the spectroscopy of solids. In addition to the Russian papers, lectures were given by the visitors on various subjects; among them may be mentioned Prof. Ladenburg's verification of the 'negative dispersion,' also predicted by Kramers (see NATURE, Sept. 22, p. 438).

The general condition of Russian scientific workers seems to be more favourable than it was reported to be a few years ago. Their labours are very directly encouraged under the present regime, and, apart from the general impoverishment of the country, their chief hardship appears to be a sense of isolation due to the great difficulty they have in visiting other countries. Their guests will certainly all try to mitigate this difficulty in return for such a delightful tour.

C. G. DARWIN.

Research in Aeronautics.[1]

THE keynote of the policy of the Aeronautical Research Committee during the year 1927–28 appears to have been a recognition of the importance of close co-operation with the aircraft industry and the Services on one hand, coupled, on the other hand, with a consistently scientific attitude to test and research in the problems associated with these two branches. The numerous advances recorded and the high quality of the experimental work are a full justification of this policy.

The general progress in Great Britain resulting from research is exemplified in the performance of the British seaplanes competing for the Schneider Trophy. The immediate results are of course attributable to the designers of the machines and engineers, and to the splendid piloting by the R.A.F. officers, but a great deal of preliminary ground work was covered by close co-operation between the individual designers and the trained research staff at the National Physical Laboratory. Several models of each racing type were tested in the duplex tunnel at the N.P.L. in the endeavour to obtain results at the highest possible Reynolds' number, that is, as close to full scale conditions as possible, and the conclusions arrived at, after consultations between the designers and the N.P.L. staff, led to definite improvements. The Committee quite rightly stresses the importance of close co-operation between the designer and the actual research worker, as a vital factor in progress of this nature.

The part played by joint action of a similar kind is exemplified by the development of mechanisms for avoidance of control failure during stalling. The Committee has now spent some considerable time in a close study of the forces operating during the stall, and of the actual motion of the aeroplane in that condition, in the hope of preventing the serious type of accident which frequently follows an inadvertent stall. This hope has been fulfilled, and out of the original slot system there have developed several methods for reducing this danger. In particular, the use of a slot which automatically closes at low wing incidences, and so avoids the loss of performance due to an open slot, has greatly assisted this development. Meanwhile, various methods of using slots at the wing tips are being extensively tried in the Services and upon civil aeroplanes.

Valuable work is also recorded on the problem of wing flutter; the aerodynamic and structural factors

[1] Aeronautical Research Committee. Report for the Year 1927–28. Pp. 68. (London: H.M. Stationery Office, 1928.) 2s. net.

that originate it have been analysed, and studied experimentally on models, while modifications in design have been suggested with the view of its reduction, if not actual elimination.

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Societies and Academies.

LONDON.

Society of Public Analysts, Oct. 3.—**G. W. Monier-Williams**: Polarimetric determination of sucrose in milk and sucrose mixtures. A method has been based on the work of Jackson and Gillis and on the observations of Vosburgh and of Zerban, on the effects of concentration and temperature on the specific rotation of invert sugar. Angular notation is used as being more suitable for general work than the saccharimetric notation commonly used by sugar chemists.—**T. McLachlan**: The analysis of starch sugar degradation products by selective fermentation. The method of selective fermentation by different yeasts is the most satisfactory. The yeasts used are *S. Frohberg*, *S. Saaz*, and *S. exiguus*; the difference between the total solids of the blank and the solution fermented by *S. exiguus* gives the amount of dextrose and lævulose; the difference in total solids in the solutions fermented by *S. exiguus* and *S. Frohberg* represents maltose; whilst the difference between the total solids after fermentation by *S. Frohberg* and *S. Saaz* gives other fermentable sugars. The amount of dextrins is calculated from the optical rotation.—**W. R. Schoeller** and **E. F. Waterhouse**: Investigations into the analytical chemistry of tantalum, niobium, and their mineral associates. (13) A new method for the separation of zirconium and hafnium from tantalum and niobium. The process is based on the precipitation of the oxalo-earth acids by tannin in weakly acid solution, zirconyl oxalate remaining dissolved. The method described earlier of fusion of the mixed oxides with potassium carbonate, has been perfected; a single fusion may be sufficient for the separation of the bulk of the earth acids. The balance is then separated from the zirconium residue by the tannin procedure. The latter is a delicate test for the detection of the smallest quantities of earth acids in zirconia.

SHEFFIELD.

Society of Glass Technology (Bournemouth meeting), Sept. 21.—**I. Kitaigorodsky** and **S. Rodin**: The value of the expansion factor of aluminium oxide in glass. The thermal expansion coefficient of glass depends upon its composition and rises with the increase in the percentage of alkali and lime, and falls as the content of alumina and silica increases. In calculations of the theoretical thermal expansion coefficient of glass, the value of the factor for alumina must be taken as 0·52, as previously determined by S. English and W. E. S. Turner, and not as 5·0, the value given by Winkelmann and Schott.—**D. Starkie** and **W. E. S. Turner**: A study of the ultra-violet light transmission of glass. Photographs of the light transmitted by seven commercial ultra-violet glasses were obtained. They were Corex, Vita-, Sanalux, Holvi-, Helio-, Quartz-Lite, and Uviol glasses. The percentage transmission at each point of the spectrum for these seven glasses was also determined, a platinised-quartz wedge photometer being used. Transmission curves extending from a wave-length of 7000 A. to 2000 A. have been drawn. The transmission of solar ultra-violet rays is roughly proportional to the iron content. The amount of ferrous iron was roughly 30 per cent of the total iron. Six glasses were exposed, under the conditions to which an ordinary window pane is subject, for 3 months, and the decrease in transmission of the solar ultra-violet rays was measured. Four specially prepared laboratory glasses containing only iron and platinum as impurities, showed no change in transmission when exposed to the sun's rays or to those from an artificial source of ultra-violet light. Measurements of transmission were also made for a series of specially prepared soda-lime glasses. The parent glass was 75 per cent SiO_2, 10 per cent CaO, and 15 per cent Na_2O, and ferric oxide was added in increasing amounts as the series progressed. As the iron content increased, the limit of transmission in the ultra-violet moved progressively towards higher wave-lengths. Plotting iron content against wave-length limit yielded a smooth curve, from which it could be deduced that a glass perfectly free from iron and platinum would have a transmission limit of 2200 A. approximately.

PARIS.

Academy of Sciences, Sept. 17. **A. Lacroix**: The genesis of the jadeite of Burma.—**Bigourdan**: The observatory of Delambre, at the rue de Paradis. Delambre made observations at this observatory in 1798 and 1799 for determining the latitude of Paris.—**Georges Giraud**: A method of solving the problem of Dirichlet for linear equations.—**J. Chokhate**: The approximation of continuous functions by the aid of polynomials or of limited trigonometric series.—**D. Menchoff**: The conformal representation of plane domains.—**M. Winter** and **Paul Lévy**: Vibrating spaces.—**G. Delépine**: The marine fauna of the Carboniferous of Asturia (Spain).—**A. Guichard**: The existence of fibro-vascular bundles with inverse orientation in the leaf of *Cladium Mariscus*.—**Jules Amar**: The question of alcohol. From a survey of experimental work on the behaviour of alcohol in man, two facts are regarded as proved. Alcohol from wine or beer, in moderate doses, is a heat-producing agent: under no conditions can muscular or nerve energy be derived from the consumption of alcohol.

ROME.

Royal National Academy of the Lincei, May 20.—**P. Burgatti**: Properties of the axial homographs in a Euclidean S_n with application to Frenet's formula.—**A. Bemporad**: Observations made during the solar eclipse of June 29, 1927, at the Royal Capodimonte Observatory. The results obtained with two pyrheliometers of different types confirm the law of diminution of the radiating power of the solar disc in passing from the centre to the periphery, formulated by the author on the basis of observations made by Secchi, Vogel, Langley, and Frost, but fail to confirm the law deduced by Julius, which would indicate a more rapid diminution. The recent observations of Schwarzschild, Villiger, and Abbot are also in good agreement with the results obtained, which also support the author's hypothesis that the absorptive power of the atmosphere increases in the neighbourhood of the maximum phase of a solar eclipse.—**Q. Majorana**: A photo-electric phenomenon detected by means of the audion.—**L. A. Herrera**: Cellular figures in rhyolite. Specimens of rhyolites from the Contepec district of Mexico exhibit an abundance of distinct cellular figures, produced by imperfect crystallisation of the silica. Solution and other influences have modified the form of the figures which, by mutual compression, have assumed the appearance of the hexagonal structure of tissues and of imperfect mitosic figures. Silica, which is widespread in Nature, both in organisms and elsewhere, appears to be an antagonistic colloid which plays a part in modelling living and pseudo-living forms and in breaking down the barriers between the different departments of Nature.—**T. Boggio**: Homographs and differentials relating to a curved space. In conjunction with C. Burali-Forti, the author has given in "Espaces courbes et critique de la relativité" proofs of certain well-known properties of curved spaces. It is now shown that simpler proofs are

possible by considering the curved space itself, rather than the Euclidean space representing the curved space.—**G. Colonnetti**: New contribution to the theory of elastic co-actions and its technical applications.—**C. Ferrari**: The plane lamina and the Kutta-Joukowski law. The considerations recently advanced by the author are extended to furnish a proof of this law.—**A. Signorini**: The Kutta-Joukowski theorem.—**Elena Freda**: The formation of stationary electric currents in a conductor subjected to the action of a uniform magnetic field (2).—**N. Siracusano**: New contributions to the spectrum of bromine in the discharge without electrodes.—**F. Rasetti**: Wave mechanics of an alkaline atom in the electric field (1).—**G. Malquori**: (1) The system $KNO_3 - HNO_3 - H_2O$ between 25° and 60°. The behaviour of this system at 40° and at 60° is similar to that previously observed at 25°, the amount of potassium nitrate passing into solution at first diminishing and then gradually increasing as the acidity is increased. The depression of the solubility of the nitrate produced by small proportions of acid is more marked at the higher temperatures, whereas the augmentation in solubility due to larger amounts of acid shows the opposite behaviour. The influence of nitric acid on the solubility of potassium nitrate cannot be regarded as an indication of the existence in solution of complex compounds diminishing in stability as the temperature rises.—(2) The system $KNO_3 - Al(NO_3)_3 - H_2O$ at 0°, 40°, 60°. In this system the only solids in contact with the solutions are the two salts, KNO_3 and $Al(NO_3)_3 \cdot 9H_2O$. The amount of potassium nitrate in the solution saturated with the two salts increases slightly as the temperature is raised.—**A. Ferrari** and **A. Baroni**: The importance of the crystalline form in the formation of solid solutions (1). Thermal analysis of the anhydrous system, $LiCl - CoCl_2$. The solidification curve of mixtures of these two salts is continuous and exhibits a maximum corresponding with the compound Li_2CoCl_4. In the supposed solid solutions between chlorides of divalent and univalent metals, the crystallisation interval is found to be zero, and the hypothesis is advanced that this is due to the preservation of the individuality of the unit cells of the components. The melting points of ferrous and cobalt chlorides are respectively 673° and 724°.—**B. Castiglioni**: Circulation in the southern Adriatic. Investigation of the exchange of water between the southern part of the Adriatic and the Ionian Sea by way of the Straits of Otranto reveals the existence in the straits of two main currents flowing in opposite directions.—**G. Brunelli**: Cancer and impurity of races. The hypothesis here advanced to explain the causation of cancer is based on the supposition that the characters of impure races, not completely fused, give rise, especially at the age when the internal equilibrating defences of the organisation decline, to anomalies in the rhythm of growth and to differentiation of certain cellular elements; at the same time, the regulating power of growth is disturbed by the lack of chemical equilibria in the internal liquids, the antagonisms of the hereditary patrimony are exerted more violently, and an ascending curve of anomalous growth is interpolated in the regular descending growth curve at the expense of some of the cellular elements.—**G. Brunelli** and **Lina Rizzo**: Hermaphroditism in *Perca fluviatilis* L.—**V. Rivera**: Action of strong doses of γ-rays on *Bacillus tumefaciens* Smith and Townsend. Even extremely intense doses of γ-rays are unable to kill this pathogenic organism. So long as the exposure lasts, multiplication of the organism is prevented, and development subsequent to the irradiation is greatly retarded, but all the colonies retain their pathogenic properties.

Official Publications Received.

British.

Report for 1927 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. James Johnstone. (No. 36.) Pp. 68. (Liverpool.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Lucia, 1927. Pp. iv+81. (Trinidad, B.W.I.) 6*d.*

Transactions of the Royal Society of Edinburgh. Vol. 16, Part 1, No. 4: *Calamoichthys calabaricus* J. A. Smith. Part 1: The Alimentary and Respiratory Systems—concluded. By G. Leslie Purser. Pp. 89-101+plates 2-4. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s.* 6*d.*

Annual Report for the Year 1927 of the South African Institute for Medical Research, Johannesburg. Pp. 88. (Johannesburg.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1150: Reports and Memoranda of the Aeronautical Research Committee published between 1st March 1927 and 30th June 1928. Pp. 8. 4*d.* net. No. 1162 (Ae. 326): A Summary of the Experimental and Theoretical Investigations of the Characteristics of an Autogyro. By H. Glauert and C. N. H. Lock. (T. 2597.) Pp. 5. 4*d.* net. (London: H.M. Stationery Office.)

The Salt Schools, Shipley. Prospectus for the Session 1928-1929, The High Schools, Technical School and School of Art, Shipley Evening Institutes. Pp. 154+12 plates. (Shipley.)

The Clothworkers' Departments of Textile Industries and Colour Chemistry and Dyeing in the University of Leeds. Souvenir Booklet, 1928. Pp. 27. (Leeds.)

Proceedings of the Royal Society of Edinburgh, Session 1927–1928. Vol. 48, Part 2, No. 12: An Analysis of Preferential Voting. By D. M. Y. Sommerville. Pp. 140-160. 2*s.* Vol. 48, Part 2, No. 13: Studies in Clocks and Time-Keeping. No. 4: The Present-day Performance of Clocks. By Prof. R. A. Sampson. Pp. 161-166. 6*d.* Vol. 48, Part 2, No. 14: The X-ray Examination of Coal Sections. (Preliminary Note.) By C. Norman Kemp. Pp. 167-179+8 plates. 3*s.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Canada. Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1926. (No. 687.) Pp. ii+80+7 plates. Investigations of Fuels and Fuel Testing (Testing and Research Laboratories), 1926. (No. 689.) Pp. vi+132+7 plates. (Ottawa: F. A. Acland.)

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology. No. 1: Studies on the Transport of Carbohydrates in the Cotton Plant; i. A Study of Diurnal Variations in the Carbohydrates of Leaf, Bark and Wood, and of the Effects of Ringing; ii. The Factors determining the Rate and the Directions of Movements of Sugars. By T. G. Mason and E. J. Maskell. Pp. 132. (London: Empire Cotton Growing Association.) 2*s.* 6*d.*

Foreign.

Smithsonian Miscellaneous Collections. Vol. 81, No. 4: Drawing by Jacques Lemoyne de Morgues of Saturioua, a Timucua Chief in Florida, 1564. By David I. Bushnell, Jr. (Publication 2972.) Pp. 9. (Washington, D.C.: Smithsonian Institution.)

International Hydrographic Bureau. Special Publication No. 23: Limits of Oceans and Seas. Pp. 24+1 map. (Monaco.) 35 cents.

Instituts scientifiques de Buitenzorg: "s Lands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques, Vol. 10, Livraison 2-3, Août. Pp. 145-404. (Buitenzorg.) 5·00 f.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. A New Meteor Crater. By Daniel Moreau Barringer, Jr. Pp. 307-311. The Species of Campsomeris (Hymenoptera—Scoliidae) of the Plumipes Group inhabiting the United States, the Greater Antilles and the Bahama Islands. By J. Chester Bradley. Pp. 313-337+plate 26. (Philadelphia, Pa.)

Smithsonian Miscellaneous Collections. Vol. 81, No. 1: Mexican Mosses collected by Brother Arsène Brouard, II. By I. Thériot. (Publication 2966.) Pp. 26. Vol. 81, No. 5: The Relations between the Smithsonian Institution and the Wright Brothers. By Charles G. Abbot. (Publication 2977.) Pp. iii+27. (Washington, D.C.: Smithsonian Institution.)

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 3, No. 2, December 1927. Pp. 23-80. Vol. 3, No. 3, June 1928. Pp. 81-166. (Kobe.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Fourth Series: Biology. Pp. 481-677+plates 24-27. (Tokyo and Sendai: Maruzen Co., Ltd.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 19, Part 5: Notes on *Laspeyresia glycinivorella* Matsumura, the Soy Bean Pod Borer. By Satoru Kuwayama. Pp. 261-290+plate 11. (Tokyo: Maruzen Co., Ltd.)

Institut de la Science du Feu. Les extincteurs prétendus chimiques leur inefficacité, les dangers mortels de leur emploi. Par Félicien Michotte. Pp. 77. (Paris.) 3·50 francs.

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 2, August. Pp. 105-295. 25 cents. Research Paper 6: Some Measurements of the Transmission of Ultra-Violet Radiation through various kinds of Fabrics. By W. W. Coblentz, R. Stair and C. W. Schoffstall. Pp. 105-124. 5 cents. Research Paper 7: Tinting Strengths of Pigments. By H. D. Bruce. Pp. 125-150. 10 cents. Research Paper 8: Wave-Length Measurements in the Arc and Spark Spectra of Hafnium. By William F. Meggers. Pp. 151-187. 15 cents. Research Paper 9: Tests of the Effect of Brackets in Reinforced Concrete Rigid Frames. By Frank E. Richart. Pp. 189-253. 25 cents. (Washington, D.C.: Government Printing Office.)

Technical Books of 1927: a Selection. Compiled by Donald Hendry. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1570: Mosquito Remedies and Preventives. By L. O. Howard and F. C. Bishopp. [illegible]

Diary of Societies.

FRIDAY, October 19.

Medical Officers of Schools Association (at 11 Chandos Street, W.1), at 5.—Surg. Comdr. S. F. Dudley: Microbic Dissemination in Schools.

Royal College of Surgeons of England, at 5.—Sir Arthur Keith: Demonstration of Problems in Human Anatomy which arise out of the Identification of a Skull attributed to Lord Darnley—Illustrated by Specimens.

Society of Chemical Industry (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—B. D. W. Luff: The Rubber Industry.

Institution of Mechanical Engineers, at 6.—R. W. Allen: Presidential Address.

North-East Coast Institution of Engineers and Shipbuilders (Newcastle-upon-Tyne) (Annual General Meeting), at 6.—M. S. Gibb: Presidential Address.

Royal Photographic Society of Great Britain (Pictorial Group), at 7.—Informal Meeting.

Society of Chemical Industry (Glasgow Section) (jointly with the local Section of the Society of Dyers and Colourists) (at White's Restaurant, Glasgow), at 7.15.—Dr. H. H. Hodgson: Some Random Thoughts on Chemical Themes.

Society of Chemical Industry (South Wales Section) (jointly with the Institute of Chemistry) (at University College, Swansea), at 7.30.—L. King: In a Persian Oilfield (Illustrated by Cinematograph).

Junior Institution of Engineers, at 7.30.—R. H. Sharp: Technical Advertising.

Royal Society of Medicine (Electro-Therapeutics Section), at 8.30.—Dr. J. E. A. Lynham: Some Clinical Observations on Radiation Therapy (Presidential Address).

Society of Dyers and Colourists (Manchester Section) (at Manchester).—G. E. Holden: The Fixation of Pigments on Texile Fabrics.

SATURDAY, October 20.

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon-Tyne), at 2.30.—L. H. Forster: Notes on the Conversion of Main Pumping from Steam to Electricity, with Special Reference to the Plant installed at Messrs. The Stella Coal Company's Clara Vale Pit.—A. T. Adam: Tru-Lay Wire Ropes and Tru-Loc Fittings.—*Papers open for discussion*:—The Sinking of Londonderry Colliery, Seaham Harbour, Co. Durham, by the Freezing Process, J. L. Henrard and J. T. Whetton; Extracts and Recommendations from the Report of the Water Dangers Committee, T. G. Davies; The Physical Constitution of Coal and Coal-Seams, Dr. J. G. Kellett; The Distribution of Ash in Bituminous Coal-Seams, Dr. J. G. Kellett.

Hull Association of Engineers (at Technical College, Hull), at 7.15.—W. M. W. Brungate: The Ruston Airless Injection Heavy-Oil Engine.

MONDAY, October 22.

Royal College of Surgeons of England, at 5.—T. W. P. Lawrence: Demonstrations of Surgical Specimens.

North Staffordshire Institute of Mining Engineers (at North Staffordshire Technical College, Stoke-on-Trent), at 6.—J. R. L. Allott: Methods of Working Highly Inclined Seams Outlined, as a Basis for a Discussion on their Limitations and Possibilities.

Institution of Mechanical Engineers (Graduates' Section, London), at 6.30.—H. R. Steward: Compressed Air for Mining and Industrial Purposes.

Illuminating Engineering Society (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—J. L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry.

Institution of Automobile Engineers (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—L. H. Hounsfield: The Integrity of the Technical Man.

Institute of Chemistry (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.—Major R. Bruce: Some Problems in Colloid Chemistry.

Royal Society of Medicine (Odontology Section), at 8.—G. Northcroft: The Desirability of the Establishment of a Rationalised Standard for the Prevention of Dental Disease in Children (Presidential Address).

Institution of Chemical Engineers (jointly with Chemical Engineering Group and London Section of Society of Chemical Industry).—Discussion on the Recent Visit to Canada.

Royal Aeronautical Society (Yeovil Branch).—Brig.-Gen. P. R. C. Groves: Britain's Position in World Aviation.

TUESDAY, October 23.

Royal Society of Medicine (Medicine Section), at 5.—Dr. C. P. Symonds, Dr. W. R. Reynell, Dr. T. A. Ross, Dr. R. S. Allison, Dr. R. Hutchison: Discussion on Hypochondria.

Zoological Society of London, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the Months of May, June, July, August, and September 1928.—Miss Joan B. Procter: (*a*) Exhibition of Cinematograph Film of the Komodo Dragons at present living in the Society's Gardens; (*b*) On the Remarkable Gecko *Palmatogecko rangei* Andersson.—R. I. Pocock: (*a*) The External Characters of the Giant Panda (*Ailuropoda melanoleuca*); (*b*) Some External Characters of the Sea-Otter (*Enhydris lutris*); (*c*) The Structure of the Auditory Bulla in the Procyonidæ and the Ursidæ, with a Note on the Bulla of *Hyæna*.—Major S. S. Flower: Hints on the Transport of Animals.

Royal Photographic Society of Great Britain, at 7.—F. F. Renwick: Presidential Address.

WEDNESDAY, October 24.

Institution of Mining Engineers (Annual General Meeting) (at Geological Society), at 11 A.M.—Dr. D. Penman: Atmospheric Conditions in Indian Coal-mines (Fifteenth Report of the Institution Committee on The Control of Atmospheric Conditions in Hot and Deep Mines).—C. C. Reid and A. Y. Reis: The Light given by Various Types of Miners' Lamps.—J. R. Homer: The Sizing of Coal for Briquetting.—Further discussion, if time permits, on Extracts and Recommendations from the Report of the Water Dangers Committee, T. G. Davies; Mine-rescue Work in the United States, G. S. Rice.

Institution of Automobile Engineers (Manchester Centre) (at Engineers' Club, Manchester), at 7.—L. H. Hounsfield: The Integrity of the Technical Man.

Institution of Production Engineers (at 83 Pall Mall), at 7.30.—B. C. Jenkins: Time Study and Shop Demonstration Methods.

British Psychological Society (Medical Section) (at Medical Society of London, 11 Chandos Street, W.1), at 8.30.—Dr. R. D. Gillespie: Personality and Psychoneurosis.

THURSDAY, October 25.

Institution of Mining Engineers (Annual General Meeting) (at Geological Society), at 10 A.M.

Iron and Steel Institute (at Engineers' Club, Birmingham), at 4.—J. G. Pearce: The Use and Interpretation of the Transverse Test for Cast Iron.—L. B. Pfeil: The Change in Tensile Strength due to Ageing of Cold-drawn Iron and Steel.—S. H. Rees: Some Properties of Cold-drawn and of Heat-treated Steel Wire.

Child-Study Society (at Royal Sanitary Institute), at 6.—Dr. C. J. Thomas: Child Study and the Health of the Child.

Institution of Electrical Engineers, at 6.—Lt.-Col. K. Edgcumbe: Inaugural Presidential Address.

Institution of Civil Engineers (Yorkshire Association) (at Hotel Metropole, Leeds), at 7.30.—Prof. W. T. David: Address.

Royal Society of Medicine (Urology Section), at 8.30.—J. S. Joly: The Cystoscope.

Coke Oven Managers' Association (at Hotel Great Central).—Annual General Meeting.

FRIDAY, October 26.

Royal Society of Medicine (Disease in Children Section), at 5.—Prof. Taillens: Dyspepsia in Children.

Royal College of Surgeons of England, at 5.—Sir Arthur Keith: The Development of the Human Foot and its Bearing on Club-foot—illustrated by specimens.

Institution of Mechanical Engineers (Informal Meeting), at 7.—R. C. Macdonald: Mechanical Plant in Gas Works.

Institution of Electrical Engineers (North-Eastern Students' Section) (at Armstrong College, Newcastle-on-Tyne), at 7.15.—L. B. Harmer: Post Office Telephones and the Public.

Junior Institution of Engineers, at 7.30.—G. W. Tookey: Legal Protection for Originality and Invention.

Royal Society of Medicine (Epidemiology Section), at 8.—Dr. F. E. Fremantle: The Authority of Parliament in Relation to Epidemic Disease (Presidential Address).

Institution of Chemical Engineers (at Institution of Civil Engineers).—Prof. A. L. Mellanby: Fluid Jets and their Practical Applications.

SATURDAY, October 27.

South-Eastern Union of Scientific Societies (Autumn Meeting).—Visits to Croydon Aerodrome and Air-Port, and to Whitgift's Hospital, Croydon.

PUBLIC LECTURES.

SATURDAY, October 20.

Horniman Museum (Forest Hill), at 3.30.—Miss M. A. Murray: Sculpture in Ancient Egypt.

MONDAY, October 22.

Bedford College for Women, at 5.15.—Miss Caton-Thompson: Excavations in the Fayum Oasis.

TUESDAY, October 28.

Royal Institute of Public Health, at 4.—Dr. A. T. Henderson: Studies in Asthma and Related Diseases. (I.) Etiological Factors: Anaphylactic and Allergic Phenomena (Harben Lectures).

WEDNESDAY, October 24.

Royal Institute of Public Health, at 4.—Dr. W. J. O'Donovan: Occupational Cancer of the Skin.

King's College, at 5.30.—Prof. A. J. Allmand: The Rôle of Chemistry in the Life of the Nation.

THURSDAY, October 25.

Royal Institute of British Architects, at 5.—T. Grut: Public Healt Buildings and Recent Improvement in Town Development in Swede (Chadwick Lecture).

Bedford College for Women, at 5.15.—Miss M. J. Tooley: Th Sanctification of Travel (Earlier Middle Ages).

Leeds University, at 5.15.—P. L. Witherby: The Method of Producin the *Times*.

Northampton Polytechnic Institute, at 8.—Dr. L. Northcott: Engi eering Steels and their Treatment. (Succeeding Lecture on Nov. 1.)

FRIDAY, October 26.

Royal Institute of Public Health, at 4.—Dr. A. T. Henderson Studies in Asthma and Related Diseases. (II.) Clinical Studies of t Asthmas: (*a*) Simple or Uncomplicated; (*b*) Infective and Refle (*c*) Asthmatic Bronchitis (Harben Lectures).

SATURDAY, October 27.

Horniman Museum (Forest Hill), at 3.30.—Miss M. Edith Durham: Montenegrin Ballad of Old Tribal Life.

CONGRESS.

October 19.

Housing and Health (at Town Hall, Windsor), at 3.—Dr. W. Butle The New House.—Miss Joan Sunderland: The Old House.

SATURDAY, OCTOBER 27, 1928.

CONTENTS.

Economics of Standardisation.

AT the recent meeting of the British Association in Glasgow, Mr. C. Le Maistre read a paper to Section F (Economic Science and Statistics) on "Standardisation and its Economic Basis." He stated that engineers and many progressive business men are, generally speaking, converted to the benefits of standardisation, carried out nationally with the strictest precautions to prevent interference with invention and design and with proper arrangements for review and revision when practical experience and progress dictate.

Since the War, the producing countries have been forced by economic pressure, and the hope of increasing their export trade, to give far greater attention to this subject than hitherto, though no country has given it greater attention or more publicity than the United States of America. This will be appreciated when it is stated that in 1926 it was estimated that more than one and a half million pounds were expended in that country on standardisation. It was stated then that there were five national standardising bodies, more than 190 trade organisations, and more than 50 government bureaux doing standardisation work of one sort or another. No doubt there has been considerable overlapping of effort, but large economies must have resulted or the work would not have been undertaken.

In Europe, while we in Great Britain have the oldest national organisation, Germany has probably the largest scheme of standardisation, and is influencing the whole of the Continent in that direction. It has often been stated that the Germans thereby hope to capture the export trade, especially of the engineering and allied industries. In any general discussion on such a subject, Mr. Le Maistre pointed out, it is of the utmost importance that the terms used by the various speakers should, if possible, be identical, or at any rate should approximate to such a degree as to avoid misunderstanding.

Most people will agree that no movement has ever been so hampered by its title as standardisation, for the term lends itself to many interpretations. It is often thought to imply crystallisation, whereas the movement, at any rate in Great Britain, stands for an entirely progressive and co-operative effort. Mr. Le Maistre distinguished between dimensional standards and those of quality, rating, performance, and tests, the latter of which enable comparisons of tenders to be made. A further division—a somewhat arbitrary one—of simplification has also to be considered.

The United States Government, up to the present, appears to have regarded simplification as the more commercial part of the process, dealing solely with the reduction of the variety of types to the least possible number. Industrial standardisation, according to the experience of the British Engineering Standards Association, provides an equitable basis for the comparison of tenders by simplifying and standardising both on the production side as well as on the commercial side, thus benefiting both the producer and the consumer. The first piece of work of the Association, more than a quarter of a century ago, was that of simplifying the large variety of steel sections then being made. These were finally reduced to 113, thereby saving at that time 5*s*. per ton, or a million a year.

It is quite possible that in America it may be found expedient to make less and less distinction between the two processes. In Great Britain experience has shown repeatedly that with the community of interest of purchaser and producer recognised in the work, simplifying practically always leads to agreement on industrial standards.

It would seem that the greatest benefits are likely to accrue in those industries which are well organised and therefore able to arrive at a consensus of opinion of their industry on the various problems involved. The success of the B.E.S.A., which is not a profit-making concern, is in large measure due to its recognition from the outset of the community of interest between producer and user. Its committees are representative of all interests concerned.

In Great Britain dimensional standardisation has not been carried so far as on the Continent, where apparently only of recent years have the economic benefits of establishing standards of comparison for tenders been appreciated. On the other hand, one must not forget that interchangeability coupled with drastic simplification has contributed very largely to the success of the American motor-car industry. According to that vast organisation known as "General Motors," a motor car consists to the extent of nearly 70 per cent of minor parts. In their works these minor parts have been reduced from 13,000 to just above 2000.

What is true of the motor industry must be true of other industries, at any rate to a considerable extent. In Great Britain, because of our geographical position, our manufacturers are very diversified and we are probably unable to undertake an extensive scheme of simplification with any possibility of economic success. On the other hand, a great deal could be done through closer contact between the technical and commercial departments of various firms. It would not do, however, to merge individuality in too much standardisation. In fact, while experience shows that industrial standards arrived at nationally, which provide an equitable basis of comparison, be it for quality, performance, or tests, are invaluable aids to economic production and tend to simplify commercial transactions, there is no doubt that too much simplification and standardisation of particular articles has the danger of leading to sterilisation.

Medieval Indian Mathematics.

Archæological Survey of India. New Imperial Series. Vol. 43, Parts 1 and 2: *The Bakhshālī Manuscript; a Study in Mediæval Mathematics.* By G. R. Kaye. Pp. iv + 156 + 48 plates. (Calcutta: Government of India Central Publication Branch, 1927.) 28 rupees; 43*s*. 6*d*.

THE Bakhshālī MS. is a valuable and interesting document in the history of mathematics. The work of editing it must have been extremely difficult and laborious, and the editor is to be heartily congratulated on the result, which really leaves nothing to be desired in the shape of aids to the study and appreciation of the contents o the MS.

Mr. Kaye is a recognised authority on the histor of Indian mathematics, and the work could no have been in better hands. Part 3 still remains to be published, but Parts 1 and 2 now before us mak a handsome volume of large quarto size containin besides five plates reproducing the original text in facsimile, a transliteration of the whole coverin 52 pages, illustrations of the script of this and otl MSS. for the purpose of comparison, and a ver comprehensive introduction of 99 pages, giving conspectus of the work with all necessary elucid tions, historical and otherwise, save for a mor detailed discussion of the language and script whi is reserved for Part 3. Chapter i. gives the sto of the finding of the MS., Chapter ii. a descripti of the material used (birch-bark) and of the prese condition of the MS., Chapter iii. the order of tl leaves; Chapter iv. describes the contents general and classifies the problems in groups, Chapter is on the exposition and method, and Chapter contains a complete and detailed analysis of tl contents of each group of problems. Chapter deals with the measures used in the MS., Chap viii. with the sources, and Chapter ix. with the of the MS. and the date of the work. For the torian of mathematics unacquainted with Sans

and its dialects the essential chapters are iv., v., vi., viii., ix.

The MS. was found in a field at Bakhshālī, near Mardan, on the north-west frontier of India. The place was near a well, with no trace of any building near it. So fragile was the MS. that the finder destroyed part of it in taking it up. The material is birch-bark; about seventy leaves are left, though some of them are mere scraps. A few are stuck together, though it might be possible to separate them. The MS. was first given to the late Dr. E. S. Hoernle, then head of the Calcutta Madrasa, to be deciphered and published. Dr. Hoernle wrote a description of it, which was published in the *Indian Antiquary* in 1883; this he followed up by a fuller account, including a translation of a few leaves, which appeared in the same journal in 1888. Dr. Hoernle also analysed a considerable part of the text, but, being prevented from carrying out his intention of publishing a complete edition, he handed over most of the material to the present editor, who at his request undertook to carry on the work. The MS. was presented by Dr. Hoernle to the Bodleian Library in 1902.

Dr. Hoernle thought that the MS. could not be later than the tenth century, but that it was a copy of an original treatise which might go back so far as the third or fourth century. Mr. Kaye has given good reasons for questioning the latter view and for believing that the date of the MS. is probably about the twelfth century (the century of Bhāskara, born 1114, and Omar Khayyám). The treatise is unquestionably Indian, but shows traces of western influence. Among the important things for the historian of mathematics are the following:

1. The arithmetical notation is on the place-value system, and there is no sound evidence of the employment of such a system earlier than the tenth century in the case of inscriptions, the eleventh in the case of coins, and the twelfth in MSS.

2. The early Indians (after Āryabhaṭa and Varāhamihira, fifth and sixth centuries) used the western sexagesimal notation for astronomical purposes, but not in purely arithmetical calculations. The Muslim mathematicians, on the other hand, did employ this notation to express ordinary fractional quantities. Now in the Bakhshālī MS. there is an example of the transformation of an ordinary fraction into its equivalent in sexagesimal fractions, namely, $\frac{178}{29} = 6 + 8^{\text{i}} + 16^{\text{ii}} + 33^{\text{iii}} + 6^{\text{iv}}\frac{6}{29}$.

3. Our MS. commonly employs a method for obtaining approximations to square roots which is not Indian. This method gives for α_1, the first approximation to the surd $\sqrt{(A^2+b)}$, the expression $A + (b/2A)$, and our treatise regularly uses this rule (*a*) for finding α_1, and (*b*) for deducing from α_1 a second approximation, α_2. The rule is Greek, for Heron gives its equivalent, and there is no doubt that it was used by Archimedes and others much earlier. On the other hand, the rule does not appear in any Indian work before the sixteenth century. The appearance, therefore, of the method in our MS. is probably due to direct western, and possibly Muslim, influence.

4. Two mathematical symbols are employed. One is a sign for the unknown quantity which is ·, the same symbol as is used for zero. The other is a sign for 'minus,' which is, strangely enough, like our sign for +, but is placed after the number affected instead of before it. The origin of the latter sign has not been explained; it would be rash to identify it with Λ, Diophantus' sign for 'minus.'

The types of problem solved in the MS. may be classified thus:

1. Systems of linear equations of the type $x_1 + x_2 = a_1,\ x_2 + x_3 = a_2, \ \ldots\ x_n + x_1 = a_n$ (n odd), and other systems of the same type as those of the famous "Epanthem" of Thymaridas the Pythagorean. The *regula falsi* is one of the methods of solution.

2. Two linear equations between three unknowns are solved in positive integers. This problem, which appears to have originated in China so early as the sixth century, is not elsewhere on record in India before Mahāvīra (ninth century). It was popular in Europe in early medieval times, and later became known as the *regula virginum* or *regula potatorum*.

3. There are cases of indeterminate equations of the second degree, one being of Diophantine type, solved as in Diophantus, and another being $xy - ax - by - c = 0$.

4. Motion-problems about persons moving at different speeds and meeting or passing one another.

5. Quadratic equations and approximations to square roots.

6. Series, especially arithmetical progressions, including the determination of the number of terms when the first term, the common difference, and the sum of the terms are given.

7. Problems of earning and spending, profit and loss.

8. Miscellaneous problems, generally solved by the rule of three.

T. L. H.

Preston's 'Light.'

The Theory of Light. By the late Dr. Thor as Preston. Fifth edition, edited by Prof. Alf ed W. Porter. Pp. xxiv + 643. (London: Macmil an and Co., Ltd., 1928.) 25*s.* net.

IN the course of time every scientific bool is overtaken by one of two fates; it lap es into oblivion or it is canonised as a classic. n the latter case there is always a temptation to extend its working life by the issue of revis d and modernised editions. There is, of course, o objection to this so long as the author himself s able to undertake it, but after his death it becon s increasingly difficult to fuse the additions wi h the original into a homogeneous whole. The n v 'Preston' is the fifth edition and Prof. Porter t e third editor, so that it would not have be n surprising, in view of the development of t e subject since 1890, if the 'joins' had shown h and there. As a matter of fact they are less evide than in the previous edition, in spite of the extensi modifications for which the present editor responsible. He has wisely removed, for examp all direct indications of interpolated matter su as were rather unnecessarily given by his pr decessors. The new diagrams are more easil recognisable, since they are all black on whit ground, whilst Preston's are nearly all white o black ground. In order partly to compensate fo the considerable additions he has made, Prof Porter has removed some matter, mainly mathe matical, which will certainly never be missed b the majority of readers.

The new matter falls mainly under the head o physical optics, but some additions are made i geometrical optics also, notably in connexion wit thick lenses and the theory of aberrations. Thi is all to the good, since the original version wa decidedly weak in these directions, but the treat ment is still rather brief in comparison with tha accorded to other sections of the subject. Anothe topic which quite justifiably claims more spac than formerly, is that of resolving power of optica instruments. In order to avoid the common confusion between this quantity and a totally different one, the so-called 'resolving power' of spectroscopes and interferometers, the term 'chromatic resolving power' is introduced to designate the latter. This is an innovation which should be welcomed and adopted by all teachers and students of the subject, particularly as Prof. Porter handles these matters in lucid and masterly fashion.

The section on diffraction has been largely reca with the view of distinguishing more definitel than is usual between the Fresnel and Fraunhof types of fringes. Some important additions hav been made to the theory of the diffraction gratin the discussion of the intensity distribution bein especially valuable in view of the misconceptior which are prevalent amongst students—and som others. The newer interferometers (Fabry-Pero Lummer-Gehrcke and echelon) are adequatel treated from the purely theoretical point of viev but it would have been very instructive to brin out more clearly the relationships between them an to contrast their properties in some detail. Th determination of stellar diameters by Michelson interferometer method is naturally the subject an additional section, and the theory is presente in a very neat and concise form. An account also given of Michelson's very recent measuremen of the velocity of light.

Of the remaining changes, the most importar is an expansion of the treatment, previously ver brief, of the electromagnetic theory, so as t include the phenomena of reflection, refractio dispersion, and propagation in crystalline medi The necessary space for this is appropriatel secured by judicious abbreviation of the elast solid theory. A minor reform, but one which wi be a great boon to the assiduous reader, is th index references are now to pages instead of t sections as formerly, but the latter system is sti retained in the text.

There are a few trivial misprints, and in sever cases references to other sections are erroneous o account of their having been renumbered. Th production is entirely admirable, and it is beyon question that the value of the book has been ver considerably increased. So has the price, but b present standards it is by no means excessive.

Experimental Zoology.

Experimental Embryology. By Prof. T. H. Morgan Pp. xi + 766. (New York: Columbia Universit Press; London: Oxford University Press, 1927. 37*s.* 6*d.* net.

UNTIL quite recently, experimental method in zoology were restricted to comparativel isolated fields of research and there seemed littl prospect of their application to problems of genera interest. For half a century the concepts of phylo genetic morphology not only maintained their ow intrinsic interest but also were the source o peculiarly sound and fruitful work. To-day, how

ever, the situation is more uncertain. There seems to be a tendency to regard morphology as a science the days of which are over, and to regard experiment as a more vigorous and hopeful source of zoological discovery. Almost at the opening of his career, a zoologist is faced with alternative points of view: Is it more fruitful to look upon organisms as a series of evolutionary and morphological units, or as dynamic systems the changes of which are themselves clues to their origin and behaviour?

Those who have felt the inspiration of the older methods may, perhaps, rightly discount the enthusiasm of recent years for new conceptions and for new technique. The phylogenetic point of view has, in the past, established a series of facts unparalleled in the history of science, and these facts must inevitably lie at the foundation of all our knowledge. That morphology should cease to demand exclusive attention is, nevertheless, a natural stage in the evolution of knowledge, and the claims of experimental zoology to-day are neither more nor less than those which have arisen in the history of all exact sciences. We cannot go on building foundations for ever; sooner or later it is profitable to erect more ambitious structures. Basing a study of function upon a knowledge of its form, experimental zoology claims to give a deeper insight into the structure and behaviour of a living organism.

It is a striking tribute to the success of its early labours that the new point of view should stand its trial so soon before the established advocates of morphology, who rightly will not temper justice with mistaken sentiment. There can be little doubt that in the not far distant future, both morphology and experimental zoology will find their common level wherever zoology is being taught. The day will come when morphologist and experimenter will realise that their goal is the same although their lines of approach appear, at first, to diverge. For the moment, it is more profitable to seek for common ground of understanding than to provoke unreal, if not unfriendly, criticism.

To those who love experiment, and to those who seek to help by understanding a novel point of view, Prof. Morgan's book is of more than usual value. For the first time, an analysis of the living embryo has been made by one who is not only perhaps the greatest of living geneticists but is also a pioneer of experimental zoology. The value of the book not only lies in a rich accumulation of facts but also in the point from which these facts are viewed. The living embryo is neither a series of microscopic sections nor is it an amorphous mass inside a test-tube. Throughout the pages of this book there is a delightful absence of technical conceit, and a commendable lack of wearisome morphology. For this reason the book will be read with pleasure and delight by those whose views are widely different. Relevant facts are not excluded because they are old, but with critical ability of a high order the author welds together data from ever-widening fields of research.

Few specialists will read Prof. Morgan's work without finding points for criticism. Some will read with surprise the chapter devoted to the mechanism of organ formation. Others will find it difficult to afford support to the view that "there is nothing in the changes in shape of the different parts of the embryo that is beyond the range of explanation of ordinary physical and chemical processes. If by means of surface tension and of swelling we can account for so many of the initial steps in organ formation, it seems not unreasonable to expect that a fuller knowledge of other changes may furnish equally simple solutions."

These remarkable statements seem to be based on a very doubtful analogy between a living gastrula and certain very simple colloidal systems. Analogies of this type, though interesting in themselves, are liable to be dangerous and deceptive guides. No simple explanation of biological phenomena is likely to be true, nor should it be entertained unless capable of experimental proof. One feels that, at times, Prof. Morgan's enthusiasm for new methods leads him further than is generally regarded as safe. To labour such criticisms would be unfortunate. To run too fast is better than not to run at all, and when the pace is set by a man of outstanding ability, it is for us to follow if we can.

To Prof. Morgan the value and significance of experiment has long been obvious, and his book will do much to establish and consolidate a growing science. It is the first attempt to raise, on the foundations of morphology, an edifice not unworthy of the past.

J. G.

Cotton and Spinning.

Studies of Quality in Cotton. By Dr. W. Lawrence Balls. Pp. xxvii + 376 + 18 plates. (London: Macmillan and Co., Ltd., 1928.) 20*s.* net.

IT would not be correct to describe this book either as a text-book or a research report; nor yet even a philosophical discourse: for it is something of all three, and, withal, undoubtedly the most interesting and stimulating that has been written round the subject of cotton. As the author

Two Swiss geologists, H. Adrian and H. Hintermann, deal with travel in Ecuador, from experience gained on reconnaissance trips in 1924 and 1925. Although they state that their visits were comparatively short, they appear to have gained a good general knowledge of the country, its customs, and means of transport. N. H. van Doorninck and H. J. Schuiling, mining geologists connected with the Union Minière du Haut Katanga, deal with the Eastern Congo in a useful article which supplements that on East Africa, by P. A. Wagner and T. G. Trevor, included in the first volume of the series.

In the introductory section of his article (in German) on northern Manchuria and the Amur and Maritime Provinces of the Russian Far East, E. E. Ahnert has condensed a large amount of detailed information concerning the physical conditions of the region, and illustrates this account by several sketch-maps. Both this information and his review of the progress of the topographical and geological survey of the region should be useful, since much of the literature is in Russian, as shown by his bibliography. Equally detailed is his information concerning suitable equipment, convenient centres for exploratory work, prices, etc. The last article, in which J. B. Scrivenor deals with some aspects of travelling in the Malay Peninsula, is shorter and less detailed than the others.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Abteilung 1, Teil 2: *Histologie.* Lieferung 22, Band 5: *Die pflanzlichen Trennungsgewebe.* Von Dr. H. Pfeiffer. Pp. viii + 236. (Berlin: Gebrüder Borntraeger, 1928.) 16 gold marks.

THE separation of plant parts from the parent organs has been much studied in more or less isolated examples, but for the first time the very scattered results have been fully classified and considered as aspects of one subject in the above work. The classification of abscission tissues is under three main headings: the separation of withering or dead organs (including the fall of leaves in autumn, of flower-parts after pollination, and of axial organs), the severing of living parts which continue to function after becoming distinct from the parent (including processes involved in vegetative multiplication and sexual reproduction), and the pathological production of tissues causing the separation of plant-parts. A summary of the general descriptive anatomy of abscission tissues follows their detailed classification.

In an attempt to define the causes underlying the formation of tissues leading to the separation of plant-parts, the author emphasises the absence of general theories and confesses that though partial explanations, especially of an ecological or biological (and, it appears, partly of a teleological) nature, have been suggested, no unifying working hypothesis has yet been obtained. The need for further research in different branches of the subject is often indicated. The work is illustrated with 36 text-figures, and is provided with a list of cited literature, occupying 19 pages, and with indexes.

Photography, its Principles and Practice: a Manual of the Theory and Practice of Photography designed for use in Colleges, Technical Institutions, and by the Advanced Student of the Science. By C. B. Neblette. Pp. xviii + 644. (London: Chapman and Hall, Ltd., 1927.) 30*s.* net.

IT is a considerable time since a text-book of photography was available for college students of the subject, and during that time a large amount of investigation has been carried out, and many interesting and important results obtained. This volume is notable as being the first, at least in the English language, to incorporate these results and present them in a connected manner.

We believe that the author has had considerable experience as a teacher of photography, and being well qualified for the task, he has produced a very praiseworthy work. Being the first edition, and practically a pioneer with regard to the more modern developments, one must not expect that freedom from errors, chiefly typographical, that may very properly be looked for in a subsequent edition. Although it is a large book, of course every item has to be summarised, and there is much scope for variety of opinion as to how the available space shall be divided among the many sections of the subject. We take one example only. The author says that "wet collodion is still unsurpassed for line work," but he does not treat of this process, which is important, for theoretical as well as practical purposes, except in a cursory manner in the general historical introduction. However, we welcome this useful addition to photographic literature.

Vertebrate Embryology: a Text-book for Colleges and Universities. By Prof. Waldo Shumway. Pp. viii + 314. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 18*s.* 6*d.* net.

AN excellent introduction to the comparative study of embryology, dealing mainly with *Amphioxus*, the frog, the chick, the pig, and man, with a concise but illuminating discussion of the embryological aspects of genetics, and useful technical instructions for making and staining serial sections of embryos. The fact that the book is illustrated by Miss Katharine Hill (Mrs. Paul) confers upon it its outstanding distinction. The figures are so clear and diagrammatic as to be self-explanatory.

Notes on some Birds of Dar es Salaam. By Cecily J. Ruggles-Brise. Pp. xviii + 96 + 20 plates. (Norwich and London: Jarrold and Sons, Ltd., n.d.) 4*s.* 6*d.* net.

MISS RUGGLES-BRISE in this little book gives quite an interesting account of many of the common birds of the provinces about which she writes. It is true that we shall be disappointed if we expect to obtain any new information or any matter of scientific interest; but visitors to this part of Africa will find the book will help them to name some of the birds they see. The pen sketches of the birds are rather crude, but the few photogravures are quite charming.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Action of Light on Celluloid stained with Malachite Green.

IT has been shown by Pettit (*Astrophys. J.*, vol. 64, p. 43; 1927) that green celluloid on prolonged exposure to the sun turns dark, and transmits only deep red and infra-red rays. He states that "the transmission curve for this solarised green celluloid is practically identical with that of ordinary green celluloid in the infra-red from $\lambda 0{\cdot}7$ to $2{\cdot}0\ \mu$, the transmission bands in the green $\lambda 0{\cdot}50\ \mu$ and ultra-violet $0{\cdot}36\ \mu$ being completely suppressed. This solarised celluloid forms the only screen to the writer's knowledge which has a sharp cut off at $0{\cdot}7\ \mu$, transmits no radiation from this point to $\lambda 0{\cdot}23\ \mu$ and transmits the infra-red beyond $\lambda 0{\cdot}7\ \mu$ with an efficiency of 80 to 90 per cent."

My interest was aroused by this observation primarily because I wished to make use of such a screen, but I have been led on from this to investigate the action of sunlight on green celluloid more closely.

Mr. Pettit most kindly sent me a specimen of the green celluloid which he uses, and also a finished filter made up of three superposed layers of the solarised material. I was able to obtain a similar green celluloid of rather paler tint in England, which showed the same reaction towards sunlight, and on enquiry of the makers they informed me that the colouring matter was the aniline dye called malachite green.

It was found that the green celluloid, after darkening to a certain extent without much obvious change of tint, turns bluish, then plum-coloured, and then deep red. The red colour becomes lighter, and finally fades away, leaving the celluloid almost colourless. The intermittent character of sunshine in England makes it difficult to give any definite statement as to how long these changes take to run their course, but probably the equivalent of a month's continuous sunshine is required with the celluloid I used. Naturally, the changes are slower the greater the amount of colouring matter initially present, for the outer layers must tend to screen off the effective radiation from the inner ones. For the same reason it is advisable to expose each side alternately.

Now what view is to be taken of these changes? It appears that the green colouring matter initially present is gradually converted by the action of light into a substance transmitting red only. During the intermediate stages these colouring matters are present together, and their combined action absorbs all visible light except the extreme red, which is transmitted by both. Eventually all the malachite green is converted into the red substance, which transmits much more red light than the former, but is opaque to the rest of the spectrum.

The diagrams of absorption spectra given (Fig. 1) illustrate this change. They are from visual measurements of the limits of transmission made with a Hilger diffraction spectroscope with micrometer. The position of the limits is not of course so definite as are diagramatically indicated, and the positions depend to some extent on the density of colour in the celluloid used. The transmission regions are indicated in black: *A* is the transmission of the celluloid alone as purchased, *B* of the red celluloid obtained by prolonged exposure, *C* of the intermediate stage, when both the varieties are present, and the transmission is only of the deep red portion which can pass both.

Evidently we could obtain the same effect by combining a red or orange commercial gelatine film filter with the untreated green celluloid, which might be cemented to it. Probably this is the readiest method of making up an infra-red filter, though I have not investigated its efficiency beyond the limit of ordinary panchromatic plates. It is true that in this case we give up the advantage of using a single filter, which may be secured by using the solarised celluloid. (A mixture of unaltered malachite green and a ready made orange dye in celluloid or gelatine would probably secure the same result.)

I have found that the same change from green to red may be quickly produced without sunlight by heating the green celluloid on an electric hot plate. A rather high temperature is required, and care is necessary to avoid raising it too high, which blisters the surface.

The reddened celluloid may be dissolved in amyl acetate to form a red solution.

The experiments described so far were made with commercial green celluloid. But they raise various questions of interest the answers to which could perhaps be found in technical literature, but which I have investigated *de novo* with home-made prepara-

FIG. 1.

tions. In the first place, crystals of malachite green were dissolved in celluloid varnish (celluloid in amyl acetate), and the varnish thus coloured was poured out on glass plates and allowed to dry. Coloured films so prepared were exposed to the sun, and were found to go through the same sequence of colour changes as the commercial green celluloid. I suspected that the home-made films were somewhat more quickly darkened than the commercial celluloid, but strictly comparative tests with the same initial density of colour have not been made.

Next, a clear gelatine film was prepared from an ordinary photographic plate, which was fixed, washed, and dried. This was stained with an aqueous solution of malachite green, dried, and exposed to the sun. Although its initial appearance was very similar to that of the celluloid film stained with the same sample of dye, the behaviour under exposure was strikingly different. For whereas the celluloid film becomes darker, the gelatine film becomes lighter on exposure. There is no reddening of the gelatine film, which fades in the ordinary way. The green colour becomes paler, but the film remains green so long as any colour survives.

Films prepared by simply flowing an aqueous solution of the dye on glass behave in the same way as the gelatine film, the colour progressively fading away without change.

These various experiments seem to prove very definitely that the production of the red substance in green celluloid is due to a specific action of the celluloid, which latter acts not merely as a medium to hold the dye, but as a chemical reagent. Celluloid contains nitrocellulose and camphor. It appears that the former constituent is alone necessary for

producing the red substance. An old sample of nitrated cotton was dissolved in alcohol-ether, and a few crystals of malachite green added. Glass plates were coated with this mixture, and went red on heating or on exposure to an iron arc. For lack of sunshine I have not been able to carry the change to the red stage with this agent, but the initial darkening has been observed in diffuse daylight. On the other hand, nothing analogous can be observed with camphor. RAYLEIGH.

Terling Place,
Chelmsford, Oct. 17.

Long Wave Radio Reception and Atmospheric Ozone.

FOR some time past, efforts have been continuously made to find out the relation between the signal strength of distant radio stations and magnetic and meteorological elements of the earth. The results obtained by Austin and Pickard have shown that there is some connexion between radio reception and solar phenomena, such as those due to the spots on the sun. The method adopted has been purely statistical, due to the very nature of the circumstances. Clayton, in his letter in NATURE of July 30, 1927, p. 153, pointed out the possible existence of a relation between solar radiation, sunspots, and the amount of ozone present in the air, as determined in northern latitudes by Dr. Dobson and his associates.

A comparison between radio reception and the ozone content naturally suggests itself in view of the ionising properties of the gas. This would be specially marked at sunrise and sunset, when very considerable changes in ionisation take place followed by changes in intensity and polarisation of radio waves. Unfortunately, there are at present no means of measuring the degree of ionisation of atmospheric ozone and its hourly changes. Perhaps field strength measurement of received radio signals afford some information thereon.

Since March 1926, measurements of the received field of Madras (Fort) Radio on 75 kc./sec. have been made on a special test transmission of a long dash at 0800 I.S.T. at the Radio Laboratory of the Indian Institute of Science, Bangalore, with apparatus closely following the description given by Hollingworth (*J.I.E.E.*, vol. 61, p. 501). Dr. Dobson very kindly supplied the revised mean daily ozone values for north-western Europe for the periods July-September 1926 and March-October 1927. The period common to both measurements is the six months March-August 1927.

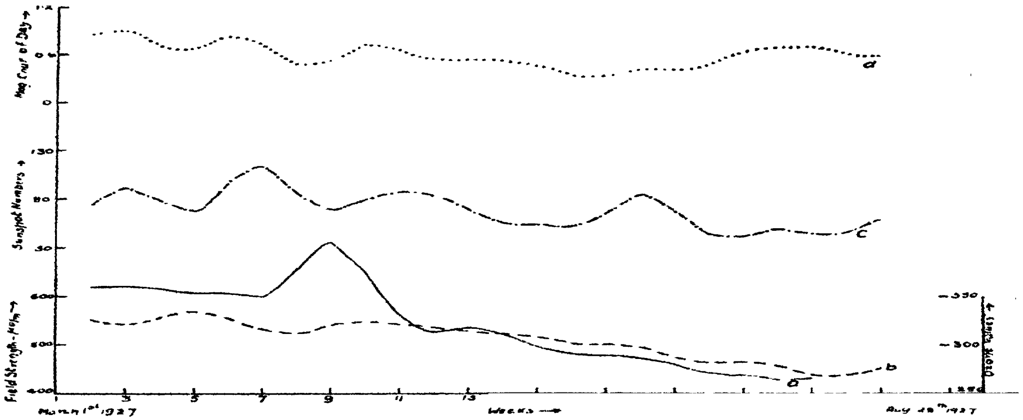

FIG. 2.—*a*, Full line, radio field strength; *b*, - - - -, ozone values; *c*, — —, sunspot numbers; *d*, ..., magnetic character of day.

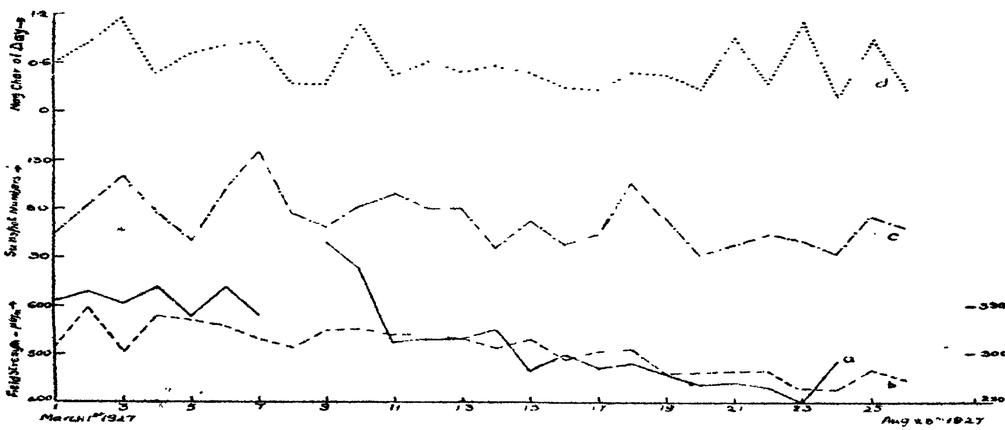

FIG. 1.—*a*, Full line, radio field strength; *b*, - - - -, ozone values; *c*, — —, sunspot numbers; *d*, ..., magnetic character of day.

The curves *a* and *b* in Fig. 1 show the weekly averages of ozone values and field strength. The similarity between them is not pronounced during March and April; later on, however, they both decrease steadily and at about the same rate. The greatest divergence occurs in the ninth and tenth weeks, when signal strength shoots up to about 150 per cent of the average for the whole period. To bring out the chief similarity by taking away the comparatively transient changes, the smoothing formula $\frac{x+2y+z}{4}$ has been used giving the curves *a* and *b* in Fig. 2. These run almost parallel to each other after the eleventh week, and roughly so between the second and seventh weeks. The reason for the comparatively sharp rise and equally sudden fall of signal strength during the ninth and tenth weeks is not understood. Neglecting the value of field strength for these two weeks, the correlation between field intensity and ozone works out 1·77 ± 0·23, which is very satisfactory considering the nature of the phenomena.

The curves show definitely that long wave field intensity is proportional to the ozone value of the

even when the averages are taken over such short periods as a week. From the ionisation theory of radio wave propagation, so far as it is understood, it looks as though the reverse should be true with propagation of very high frequency waves, say above 3×10^6 cycles per second.

The relation with sunspot activity is not so pronounced though fairly definite. Curve *c* in Fig. 1 represents the weekly averages of sunspot numbers due to Dr. Wolfer; in Fig. 2, *c* refers to the smoothed values. With little similarity in details, and with the exception of the peak in sunspots corresponding to the eighteenth week, the general tendency for a continuous decrease is evident; curve *c* brings this out a little better.

On the other hand, there seems to be no tangible connexion between terrestrial magnetism as given by the international numbers for the mean magnetic character of day; the curves corresponding to this are marked *d* in Figs. 1 and 2. Support is gradually gathering for the view that a definite relation between sunspots and magnetic storms is yet to be found; violent variations of one are not always followed by corresponding fluctuations in the other. But the importance in connexion with this note lies in the fact that one would expect a magnetic storm to be preceded or followed by some abnormality in reception. This certainly does not seem to be the case with the Bangalore observations on Madras, even over longer periods than March–August 1927.

The close correlation between ozone and reception on 4 km. wave-length is to some extent remarkable in view of the great distance, at least 8000 km., separating Bangalore and Madras from the stations in north-western Europe where the ozone values have been observed. The direct and almost inevitable conclusion is that changes in the ozone values partake of the nature of a world phenomenon. Further, the existence of this gas at a height of about 30 to 40 km. is of additional interest in view of the fact that according to some estimates, long radio waves are supposed to penetrate up to about 40 to 50 km.

It is worthy of note that an increase or decrease of sunspot activity as indicated by Wolfer's numbers does not seem to be followed always by corresponding variations in ozone or field intensity. This, along with the absence of any definite relation between sunspots and magnetic storms, lends support to the explanation offered; either that the sunspots are not all equally active in the emission of charged particles or that those emitted by some do not reach the earth's atmosphere.

The relation, over moderate distances, between temperature and long wave propagation is fairly definite. The observations on Madras show some measure of agreement with Austin's conclusion of a negative correlation between them. This is not surprising, as the temperature changes both at Madras and Bangalore are markedly similar, indicating a common cause in the upper regions of the atmosphere.

Examination of barometric pressure changes have given no information of any value.

A detailed report is to be published at an early date. It would, however, be of interest to know if other investigators have discovered any relation in this connexion.

I am indebted to the Astronomer Royal and Dr. . R. Ramanathan for the magnetic data and to r. Dobson for the ozone values. My thanks are due › Prof. J. K. Catterson-Smith for permission to send is letter.

K. SREENIVASAN.

Somerton, Aug. 23.

Definition of 'Area' in Contact Catalysis.

IT is evident that the apparent area of an irregular surface will depend on the size of the object used for measuring it. This has been clearly expressed by Constable (NATURE, Sept. 15, p. 399), the 'maximum' area of a surface being defined as that of "the envelope of the monatomic film of hydrogen atoms closely packed, all in contact with each other and with the catalyst, and completely covering it." This, as an arbitrary definition of area, is a useful one, though it is questionable whether it has any real physical significance, the work of Davisson and Germer on the diffraction of electrons indicating that the packing of gas atoms adsorbed on a metal surface follows that of the metal atoms in the crystal lattice.

However, in studying the catalytic properties of a surface for a particular reaction, the area which is of most interest is not this arbitrarily defined 'maximum' area, but is rather that area of the catalyst which can be reached by the particular reactants considered. For example, in studying the electrolytic deposition of hydrogen ions at the surface of a metallic cathode, the area to be considered is that area which is accessible to the hydrogen ions and on which they can deposit or be adsorbed, and this has been defined (Bowden and Rideal, *Proc. Roy. Soc.*, A, **120**, 80; 1928) as the 'accessible area' for this particular reaction. In this case it is limited by the area of the metal which is wetted by the electrolyte, and irregularities in the metal surface which are too small to be penetrated by molecules of the electrolyte are excluded since these portions cannot be available for the reaction. In general, since catalytic surfaces are probably heterogeneous, the reactants on reaching the surface may rebound, they may be adsorbed or they may react in various ways, and in studying the kinetics of the system or comparing the catalytic activity of two surfaces it is a knowledge of this 'accessible area' which is likely to be of the most interest.

Last year, during a general study of hydrogen deposition, a method was evolved for the measurement of the areas of metallic surfaces by the electrolytic deposition of hydrogen from solution (*Proc. Roy. Soc.*, A, **120**, 59) and was then outlined to Dr. Constable in this laboratory. When some months later, in a footnote added to a paper (*Proc. Roy. Soc.*, A, **119**, 197; 1928), he referred to the possibility of such a method being used, it was naturally assumed that he referred to this. The assumptions made are of course fully discussed in the original paper, and it may be seen that there is considerable experimental evidence for them. It has been stated (Constable, NATURE, Sept. 15, p. 399) that in this method the hydrogen covers only a small fraction of the surface; but it should again be pointed out that the quantity measured is the amount of hydrogen *added* to the surface in order to cause a given change in the electrode potential. This quantity is small, but it does not follow from this that the hydrogen is sparsely distributed over the plate since the initial surface concentration of hydrogen is not known with any certainty. In fact there is some evidence from surface tension data that at the potential of the reversible hydrogen electrode a large proportion of the accessible metal atoms are already covered with hydrogen.

The amount of hydrogen present on the surface per unit of 'accessible area' is a reasonable definition of its surface concentration, and this has been called the 'true surface concentration of hydrogen' in order to distinguish it from the apparent concentration. Using this method, the rate at which the surface catalyses the deposition of hydrogen ions can be investigated simultaneously with the measurement of the area

which is accessible to the hydrogen ions, and the effect of different methods of treatment of the metal surface on both these factors can be studied.

It is probable that the catalytic activity of a surface depends mainly on the first few atomic layers, and it is the nature and configuration of these surface atoms which are of most interest in contact catalysis. It would seem possible that the electrolytic method can give some information as to the 'area' and properties of these surface atoms. In the interference method, the metal is heated in oxygen until an oxide layer is formed of sufficient thickness to be visible by interference colours. Making assumptions as to the optical properties of the surface and the chemical composition, density, and homogeneity of the oxide layer, its 'area' can be calculated. This method, which has been developed by Constable (*Proc. Roy. Soc.*, A, **119**, 197; 1928), is a valuable one, capable of giving interesting information of the structure of thin metallic films, but since it necessarily involves the destruction of the metal surface to a depth of some thousand atoms, the information it can give as to the 'area' and configuration of the initial surface atoms is limited. Also, since it disregards the fine structure of the metal surface (inequalities less than 10^{-5} cm. being ignored), it is to be expected that it would give a value for the 'area' which is less than that of the metal surface accessible to hydrogen ions from solution, and experimentally this is found to be the case. The surface which has been measured by the oxidation method is nickel, and the 'area' found for the activated metal varies from 1·3 to 4·5 times its apparent area. By the electrolytic method the 'accessible area' of rolled metal may be from two to five times its apparent area, for sand-papered metal approximately ten times, and in the case of nickel, activation by alternate oxidation and reduction causes an increase to forty-six times its apparent area.

F. P. BOWDEN.

Laboratory of Physical Chemistry,
Cambridge, Sept. 24.

Vitamin-D and Iso-Ergosterol.

IN connexion with the problem of the constitution of vitamin-D, the following comparison of the absorption spectra of irradiated ergosterol and of unirradiated iso-ergosterol is of interest.

Fig. 1 gives the photometric curves [1] of the spectra of (*a*) 0·01 per cent alcoholic solution of ergosterol,

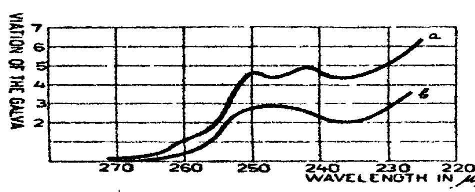

FIG. 1.

irradiated in such a manner that the absorption in the region of 270-300 μμ has disappeared, and has given place to a rather strong absorption with a maximum at about 247 μμ. This phenomenon is shown in the literature to be characteristic for the formation of vitamin-D.[2, 3] (*b*) 0·008 per cent alcoholic solution of iso-ergosterol.

The absorption spectra were taken with a discharge tube emitting the continuous hydrogen spectrum as light-source. When the absorption tray is filled with alcohol, this light-source gives with our spectrograph and plates an absolutely constant blackening of the plate in the region 300-245 μμ. For shorter wave-lengths the blackening falls off, first slowly, then more quickly, in proportion as the sensitivity of the plate diminishes. A comparison of the two curves shows immediately that they have the same character. This is clear from the similar shape of their basis-curves. Only curve (*a*) shows in addition three little peaks at wave-lengths 262, 250, 242 μμ. This is a very interesting fact, as two of these bands, at 262 and 250 μμ, exist already in the absorption spectrum of unirradiated ergosterol. This is shown by Fig. 2, which gives

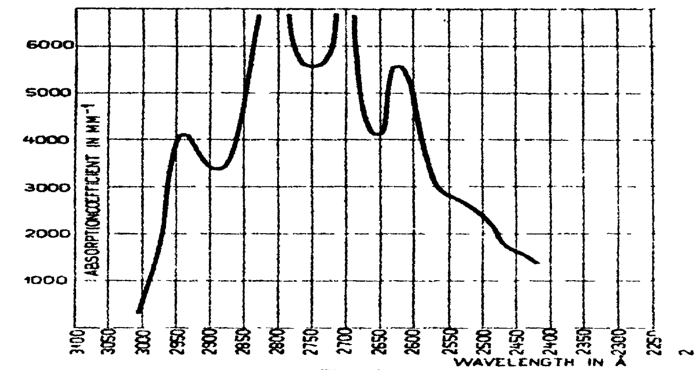

FIG. 2.

the absorption coefficient of unirradiated ergosterol as a function of the wave-length. In this figure these two bands are clearly visible. These bands, contrary to the three longer bands of unirradiated ergosterol, do not decrease in strength by irradiation.

These facts suggest the following hypothesis: the ergosterol has two types of absorption bands, connected with different parts of the molecule. By irradiation such that vitamin-D is formed, the first system ($\lambda_1 = 293_5$, $\lambda_2 = 281_3$, $\lambda_3 = 270_9$) makes way for the characteristic absorption band of iso-ergosterol, which would mean that the corresponding part of the molecule undergoes the same change in constitution by irradiation as by the transformation of ergosterol into iso-ergosterol by the chemical method of Reindel.[4] Another part of the molecule obviously does not change its constitution. This follows from the permanence of the second system of bands ($\lambda_4 = 262$, $\lambda_5 = 250$). The meaning of the peak at $\lambda_6 = 242$ μμ is not yet elucidated.

Like vitamin-D, the iso-ergosterol remains unchanged by irradiation with ultra-violet light of wave-length longer than 270 μμ, and is destroyed by light of wave-length of about 250 μμ, as is shown by the disappearance of the absorption bands.

A. VAN WIJK.
E. H. REERINK.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Sept. 18.

[1] It must be noted that in the curves (Fig. 1) only the transmission of the photographic plates in relation to the wave-length is given, and not the absorption coefficients themselves. These will be published in due course, when the whole material has been worked out.

[2] For example, Heilbron, NATURE, vol. 120, p. 617; 1927.

[3] A study concerning the change in the absorption spectra of ergosterol and other substances by irradiation with different wave-lengths is in progress, and will shortly be published in full.

[4] Reindel, *Lieb. Ann.*, vol. 452, p. 34; 1927.

The Magnetic Moment of the Electron.

The hypothesis of the spinning electron assigns to the electron an angular momentum $h/4\pi$ and a magnetic moment $eh/4\pi mc$. Dirac[1] showed that the spectroscopic duplexity pointed out by Heisenberg can be explained more satisfactorily by modifying the wave equation. In his theory the angular momentum is still $h/4\pi$. The magnetic moment μ, however, is only approximately the Bohr magneton μ_0. Using Darwin's[2] explicit expressions for the four ψ's, the magnetic moment of the electron in the field of a charge Ze is easily calculated. The result is

$$\mu = \mu_0(1 + 2\sqrt{1 - \alpha^2 Z^2})/3,$$

where α is the fine structure constant $7 \cdot 3 \times 10^{-3}$. Substituting $Z = 92$ for uranium, we obtain $\mu = 0 \cdot 83\mu_0$. Since in the nucleus there may be very intense fields, the conditions in it are approximated by using large values of Z. The highest value that may be used is 137, because higher values make the solution inapplicable. For this Z the moment decreases to $(1/3)\mu_0$. Performing the same calculation for excited states with radial quantum number $= 0$, we find, using Darwin's notation and his first type of solution,

$$\mu = (1 + 2\sqrt{(k+1)^2 - \alpha^2 Z^2})(2k + 3)^{-1}\mu_B,$$

where μ_B is the ordinary magnetic moment of the state in question calculated neglecting relativity. The theoretically possible minimum of the above expression is $(2k + 3)^{-1}\mu_B$. Thus in intense fields such as may exist in the nucleus, the magnetic moment of the electron may be less than a Bohr magneton.

Dr. R. S. Mulliken pointed out to me that in several instances isotopes supposedly containing odd and even numbers of nuclear electrons have practically identical spectra. If the magnetic moment of the electron were always μ_0 one of the two isotopes would have a resultant nuclear magnetic moment which would modify its spectrum very noticeably. Therefore he concluded that for the nuclear electrons μ may be much smaller than μ_0. Dirac's theory is qualitatively at least in agreement with this conclusion of Mulliken. It shows that the electron spin can be modified by the presence of intense electric fields, and that in the cases mentioned above the magnetic moment is smaller than a Bohr magneton.

Barnett's[3] and Emil Beck's[4] measurements of the gyromagnetic ratio gave in contradiction to those of Chattock, Sucksmith, and Bates[5] a value which indicates a somewhat smaller μ than would correspond to a Bohr magneton. There may be other reasons for this than the dependence of μ on the type and strength of the field. This may be, however, one of the reasons. A central field of the order of about 50e corresponds to the observed deviation.

G. Breit.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington.
(Temporarily in Zurich.)

[1] P. A. M. Dirac, Proc. Roy. Soc., A, vol. 117, p. 610; vol. 118, p. 351.
[2] C. G. Darwin, idem, vol. 119.
[3] S. J. Barnett, Proc. Amer. Acad., vol. 60, p. 127.
[4] Emil Beck, Ann. der Phys., vol. 60, p. 1[illegible]
[5] Sucksmith and Bates, Proc. Roy. Soc., vol. 104, p. 499; [illegible] p. 638.

The Depth of Field and Resolving Power of Optical Instruments.

The belief of some physicists that the significance of [illegible]ry's work of a hundred years ago on the character of optical images is rarely appreciated by users of optical instruments, will be strengthened by a recent letter [illegible] Nature. It calls to mind a statement in Lord Rayleigh's address to the Royal Society in 1907: "In looking into the more recent progress of Geometrical Optics, I have been astonished to find how little correlation there has been. . . . In this subject it would appear that a man cannot succeed in making even his own countrymen attend to him." Lord Rayleigh himself appears to have fared no better than his great predecessors. More than forty years ago he discussed, in terms of the wave theory, the accuracy necessary in focussing, and verified his theory by experiment. Nevertheless, so far as I can recall, every book on optics or photography that deals with this question bases the discussion on the geometrical theory. The tables for finding depth of field published each year in the *British Journal Photographic Almanac*, and a recent contribution to Nature, rest on the same assumptions.

Unfortunately, the geometrical method has a habit of returning the wrong answer to questions affecting the use of optical instruments. It leads us to expect an improvement in the definition given by a lens when the aperture is diminished, but the wave theory leads to the opposite conclusion. It declares that the depth of field should vary inversely as the first power of the diameter of the aperture, but the wave theory substitutes the second power. These two examples, out of many that might be cited, show the importance of considering optical questions in accordance with the concepts of the wave theory. The geometrical method, if employed at all, should only be used to find relations between loci where perfect ray convergence may be assumed. When tolerances are discussed by the wave method, it turns out that the quantities involved are invariants as found by this restricted geometrical method. The reason for this correspondence becomes clear when the wave theory is employed throughout; it will be sufficient here to give examples.

If y is a small length perpendicular to the axis, meeting it in the same point as a ray inclined at an angle θ with the axis, $\mu y \sin \theta$ is invariant on refraction if this elementary length is imaged without aberration. The parallel theorem states that two points in the same transverse plane will not appear distinct in the image if their separation y is less than the value which satisfies $\mu y \sin \theta = \kappa\lambda$, where κ is a constant and θ is the inclination to the axis of the extreme ray transmitted by the lens. If x represents a small length measured along the axis of the lens, the invariance of $\mu x(1 - \cos \theta)$ corresponds to a range of focus x, determined by the condition $\mu x(1 - \cos \theta) = \kappa' \lambda$, within which the minimum standard of definition depends on the constant κ'. For sensibly perfect imagery κ' should not exceed 1/4. In most photographic work values as high as 4, or even 8, are generally accepted as the equivalent of good definition. Except with high power microscope lenses, $\sin \theta$ and $1 - \cos \theta$ may be replaced by $a/2u$ and $a^2/8u^2$ respectively, where a is the diameter of the aperture and u is the distance from the lens of the point from which the elementary displacements x and y are made.

A third law of geometrical optics, which is in effect a combination of the two just mentioned, states that the longitudinal magnification is proportional to the square of the transverse magnification. In symbols, $x/\mu y^2$ is invariant. The related theorem is that the depth of field associated with the distinct rendering of points distant y apart is [illegible], K being a constant depending on the [illegible] considered satisfactory. Ev[illegible], and sensibly perfect definition, w[illegible] central diffraction discs of distinctly rendered points in contact, is attained with $K = 1/3$.

In all these expressions λ is the wave-length of the light forming the image, measured in the medium for

which the refractive index is taken as unity. Thus if points a thousandth of an inch apart, with a total depth of a tenth of an inch, were to be photographed, the value of K would be 1, and with a perfect lens the definition might be estimated as very good. The attainment of a very good negative would depend on obtaining a large enough image to make the tendency of photographic images to spread negligible. The sounder practice, though not always possible on account of the space required, appears to be to obtain a picture of the largest size required in a single operation, and not, as has been suggested, the subsequent enlargement of a small original negative.

T. SMITH.

National Physical Laboratory,
Teddington, Middlesex.

WITHOUT entering into a discussion of the correct interpretation of high power microscopic images, which is a very recondite subject, I should like to point out that Mr. Mallock's statement in NATURE of Oct. 13 that an object of alternate opaque and transparent lines cannot be separated by any method if their spacing is much less than a wave-length, is not confirmed by experience. Lines of this nature on the surface of etched steel have been photographed by visual light, which are not more than 1/140,000 of an inch in their spacing, and can also be seen when approximately of this size. There is some evidence to show that lines nearly twice as fine can be photographed by ultra-violet light of wave-length 1850.

May I direct Mr. Mallock's attention to a short note on diatom structure in the *Journal of the Royal Microscopical Society*, vol. 42, pp. 338-339, which indicates another interpretation of the results which he attributes to a lenticular structure in the object observed.

CONRAD BECK.

69 Mortimer Street, W.1, Oct. 15.

Influence of Temperature on the Raman Effect.

As has been emphasised by Prof. Pringsheim in his recent admirable report on the Raman effect (*Die Naturwissenschaften*, Aug. 3, 1928), there is a far-reaching and fundamental analogy between the be-

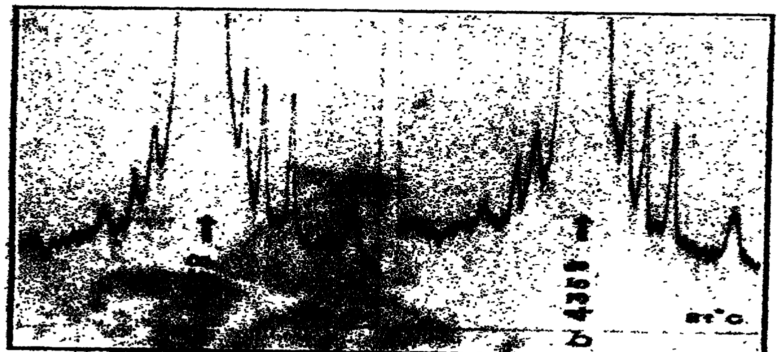

FIG. 1.

haviour of electrons and of light quanta during their collisions with material particles. The new lines appearing in the spectrum of the scattered light are the result of inelastic collisions or of super-elastic collisions of the light quanta with the molecules of the medium, according as the shift of frequency is towards longer or shorter wave-lengths. As has already been pointed out in an earlier communication (NATURE, July 7, 1928, p. 12), the lines with enhanced frequencies are usually of much smaller intensity than those degraded in frequency to an equal extent. The natural explanation of this is that comparatively few molecules are normally present in an excited state and therefore in a position to communicate energy to the light quantum. As the temperature rises, we should expect the number of such molecules to increase, and the proportion of super-elastic to inelastic collisions to rise *pari passu*.

The case of carbon tetrachloride is very suitable for an experimental test of this point, as there are numerous Raman lines with relatively small shifts of frequency in its scattered spectrum. I have made experiments which confirm this theoretical expectation. Figs. 1*a* and 1*b* are microphotometric records of the Raman spectrum of carbon tetrachloride excited by the 4358 group of the mercury arc, the former being taken at 34° C. and the latter at 81° C. It will be seen that the lines of higher frequency (towards the left) increase in intensity and those of lower frequency (towards the right) decrease in intensity when the temperature is raised.

K. S. KRISHNAN.

210 Bowbazar Street,
Calcutta, Sept. 6.

Elastic Constants of Single-crystal Aluminium Wire.

IN connexion with my investigations on certain elastic properties of solid metallic elements, Prof. H. C. H. Carpenter, of the Imperial College of Science and Technology, South Kensington, has had made for me single-crystal aluminium wires of diameters 1 mm. and 2 mm. respectively. The wires were drawn down from a single-crystal bar of diameter 0·564 inches and about 4 inches in length.

As a result of a series of carefully conducted experiments, it is found that for these specimens of wires $y = 6{\cdot}779 \times 10^{11}$ and $n = 2{\cdot}432 \times 10^{11}$ (temp. 28°–28·5° C.) The first of these two elastic constants is determined with the help of a sensitive form of extensometer responding to elongations with a few tenths of a gram; and the second, by setting suitable lengths of the wires into torsional vibrations in an air-free chamber. It will be seen that these moduli for single-crystal wires are slightly less than for ordinary specimens.

G. SUBRAHMANIAM.

Vizianagaram, India, Sept. 20.

Geological Jargonese.

THE correspondent on the above subject in NATURE of Oct. 13 gives expression to a matter of regret for many a lay reader like myself, but that regret should not be sharpened by impatience.

NATURE is a kind of mixed grill, prepared for people of widely different tastes, all of them epicures. Though your lay readers may frequently wish that they could fully understand some of the articles that are written, it should not be forgotten that the real use of NATURE is as a medium of exchange of technical information on subjects embracing the whole field of science, and it is obvious that if the geologist were to choose his language to suit the chemist, or vice versa, the value of his contribution might very well be destroyed.

If voracious feeders will consume mixed dishes they must not complain if some of the ingredients do not suit their palate.

J. P. C. DONE.

Cricklewood, N.W.2.

Phosphorescence, Fluorescence, and Chemical Reaction.[1]

By Prof. E. C. C. Baly, C.B.E., F.R.S.

ONE of the most important theories brought forward during recent years is that known as the radiation hypothesis, which was developed independently by Perrin and by W. C. McC. Lewis. Briefly stated in an elementary way, this theory postulated that molecules in general have no chemical reactivity, and that they become reactive after they have absorbed energy. In order that a specific reactivity be induced, a definite quantity of energy must be supplied to bring each molecule from its initial stage to its reactive state, this quantity being called the critical increment of energy characteristic of the specific reaction.

The Einstein law merely states that in a photochemical reaction a molecule absorbs one quantum of radiant energy, $h\nu_0$, and then becomes activated, no assumption being made as to the difference in energy content of the initial and reactive states. The radiation hypothesis states that the difference in energy content of the initial and reactive states, or the critical increment of activation, is a single quantum which can be absorbed from infra-red radiation. The critical increment of energy characteristic of a reaction is neither expressed nor implied in the Einstein law.

It is a simple matter to calculate the critical increment of a reaction from the observed change of the velocity constant with temperature, and to obtain the critical frequency ν. Not only must this frequency be one characteristic of the reactant molecules, that is to say, one that can be observed by absorption spectra measurements, but the radiation hypothesis also demands that exposure of the inactive molecules to radiant energy of that frequency should cause the reaction to take place. As a matter of experimental fact, molecules in their inactive states do not show any evidence of being characterised by frequencies equal to those calculated from the critical increments. This in itself is sufficiently significant to arrest attention, but when it was proved first by Lindemann and then in most elegant fashion by G. N. Lewis that molecules do not react when exposed to radiant energy, not only of the calculated frequency but also of a very large range of infra-red frequencies, it was felt on all sides that the radiation hypothesis had been effectively and completely disproved.

The situation thus reached is one of considerable interest. There exist on one hand large and increasing numbers of photochemical reactions which are obviously stimulated by the absorption of radiant energy. If the Planck theory stand fast, the reactant molecules must be activated by the absorption of the energy quanta $h\nu_0$, since it is well known that the frequency ν_0 is characteristic of them. On the other hand, the radiation hypothesis is based on premises which appear to be theoretically sound; nevertheless, it has been proved to be untenable. As a result the general consensus of opinion has swung over to activation by collision in reactions. It must, however, be confessed that the present position is very far from being a satisfactory one. In the case of true photochemical reactions, it is not possible to believe that activation of the reactant molecules is not produced by the direct absorption of radiant energy. In the case of thermal reactions, the evidence disproves the activation by the direct absorption of radiant energy, and activation by collision has been substituted.

When the obsequies of the radiation hypothesis had been sung, it was felt that the corpse had received decent burial. I venture to point out that this hypothesis may be divided into two parts. The first part is concerned with the critical increment of energy of a reaction, that is to say, the minimum quantity of energy, or rather the exact quantity of energy, which is required to bring a molecule from its initial state to its reactive state. Unless the whole conception of different molecular states be dropped, this conception of a critical increment stands on a sure and firm basis. The second part of the hypothesis, namely, that the critical increment can be absorbed as a single quantum of energy by a reactant molecule, is a pure assumption and one that would only be justified by a knowledge that the properties of molecules are in this respect identical with those of elementary atoms. The uncertainty which attaches itself to this assumption impresses me so strongly that I propose to exhume the body in order that the cause of death may be more fully investigated.

So far as the phenomena of chemical reaction can help us, our knowledge of the physical properties of molecules, and in particular their change from one to other states of energy content, is singularly meagre, and it would seem that little more can be gained in this direction even by the most intensive study of purely chemical processes. I venture to stress this point of view because I believe that the necessary evidence can only be gained from sources of information which are independent of the processes we wish to explain. Such independent sources of information may be found in the phenomena of phosphorescence, fluorescence, and absorption spectra of compounds.

The term phosphorescence is a broad one and includes both photoluminescence and cathodoluminescence, together with certain subsidiary phenomena. The only one of those that can serve our present purpose is photoluminescence, since a knowledge is essential of the frequency of the activating radiation as well as that of the emitted radiation.

Lenard and Klatt established the very important fact that phosphorescent emission is not a truly reversible process. It is only possible to activate a phosphore by means of radiant energy of the same frequency as that of its characteristic absorption band, which lies on the short wave-length side of the

[1] From the presidential address to Section B (Chemistry) of the British Association, delivered at Glasgow on Sept. 6.

It must be emphasised that the temperature is a most important factor, and there must be for every complex a characteristic temperature limit, below which it is completely stable. When the temperature is progressively raised above the characteristic limit, an increasing number of complexes will be resolved in unit time, and the reaction velocity will increase. It may be said, therefore, that the stability of the complexes progressively decreases as the temperature is raised above the temperature limit, and it follows that there must be an upper temperature limit above which the complex will have no measurable stability, and at this temperature the reaction velocity of a simple chemical reaction will reach a maximum and will indeed be instantaneous, if such a word can be applied to a process involving the mixing together of the reactants. The photosynthesis reaction is differentiated by the fact that it consists of two stages, and the temperature limits concern only the stability of the adsorption complex characteristic of the first stage.

The hypothesis of complex formation also offers an explanation of the phenomena of photoluminescence. There is one outstanding fact in connexion with the activation of the phosphorogen in a phosphore which indicates the presence of a complex of the type we are dealing with. In all cases where the activating wave-lengths have been measured, these are longer than those which are characteristic of the phosphorogen in the free state. This at once leads to the view that each phosphorogen molecule has formed a complex with a molecule of the diluent, and within that complex the phosphorogen exists at a level of higher energy content than the normal. The stability of the complex will be determined by the temperature as it can only be resolved into its components by the supply of infra-red radiation to make good the defect in the rotational energy of the diluent molecule. Even though the phosphorogen component is raised to a still higher level by absorption of its characteristic quantum at the ultra-violet frequency, the complex will remain in its stable state provided that the temperature is below the lower limit characteristic of the complex.

An instance of an exactly analogous phenomenon is the very striking fluorescence of benzaldehyde in concentrated sulphuric acid solution. In this case the aldehyde within the complex absorbs and radiates energy without its stability being affected. It may therefore be suggested that even after the phosphorogen has been raised to a higher level of activation than that which it reaches in the actual formation of the complex, the new state is no less stable than the complex itself. If that be so, the whole of the phenomena of photoluminescence which have been previously described will find a simple explanation. There will be a lower temperature limit below which the activated complex will be completely stable, that is to say, no phosphorescence will be observed. When the temperature is raised above the lower limit the region of partial stability will be entered and phosphorescent emission will begin, and progressive rise of temperature will progressively increase the number of complexes that are resolved and the intensity of the phosphorescence will increase. Since there are present a finite number of complexes, the total persistence of the emission will decrease. At any constant temperature between the lower and upper limits the intensity will have a definite rate of decay. Just below the upper temperature limit where the stability is vanishingly small the persistence will be vanishingly small and the intensity will be the maximum. Up to this stage the phenomena will be identical with those of a chemical reaction, the criterion of intensity of phosphorescence being substituted for the criterion of reaction velocity. When the upper temperature limit is passed the complex will no longer have any stability and will no longer exist. No phosphorescence or fluorescence will be possible, since these depend on the stable existence of the complex with its power of retaining the energy which it absorbs at its characteristic frequency in the ultra-violet. These phenomena are identical with those observed by Lenard and Klatt.

One further piece of evidence, which has hitherto not been mentioned, may now be brought forward. The hypothesis of complex formation demands that the defect in the rotational energy of the 'catalyst' or diluent component may be absorbed as infra-red radiation. In all that has gone before this defect has been supplied by raising the temperature, and the hypothesis cannot be considered as entirely justified unless it be proved that resolution of the complexes can be achieved by exposure to infra-red radiation. The fact that the most effective method of deactivating an activated phosphore and of releasing the whole of its phosphorescence is by exposing it to infra-red radiation adds a conclusive argument in support of the hypothesis.

The success that has attended the application of the hypothesis of complex formation to widely differing phenomena justifies its general application to all thermal chemical reactions. This naturally leads to the view that every such reaction depends on the presence of a catalyst. There seems little objection to this because it is a fact familiar to everyone that chemical reactivity suffers a most remarkable decrease as all impurities are removed. It is perhaps a sweeping statement to make that no thermal reaction can take place in the complete absence of a catalyst, but the fact remains that in every case which has been accurately examined the reaction velocity is zero. In inorganic chemistry the most effective catalyst is water, and H. B. Baker's work on the absence of reaction between dry substances is classical. It may be that this power of water is connected with its great ionising power towards inorganic salts, for it is possible that ionisation itself is the result of a complex between solvent and solute.

It may be claimed that the evidence brought forward from the three fields of photoluminescence, absorption spectra, and chemical reaction constitute a story that is not without interest. The one dominating influence in this story is the critical quantum of activation which has found its experimental verification.

Manuscript Herbals.[1]

THE herbals which have come down to us from pre-Renaissance days offer a vast field for inquiry, as yet imperfectly explored. Dr. Charles Singer's new memoir not only affords invaluable clues to the labyrinth of codices which confronts the perplexed student, but also illuminates the subject by treating it on broad lines and relating it to the main currents of thought. Dr. Singer believes that the herbal—or descriptive drug-list of vegetable remedies—had already assumed its definitive form in the fourth century before Christ, though no work so early in date is extant. We owe our first knowledge of Greek herbal literature to the "Historia Plantarum" of Theophrastus. The Ninth Book of this work, which may perhaps date from a period later than the death of the reputed author in 287 B.C., is believed to be a compilation from which we may gain an idea of the nature of the earliest herbals.

The most important work of the period before Christ is, however, that of Krateuas of Pontus, the medical attendant of Mithridates (120–63 B.C.); Krateuas was the first author to produce a herbal with figures, and he is thus the father of plant illustration. No actual copy of his work has survived, but Dr. Singer believes that we have the material for restoring a considerable part of it, which seems to have been used some centuries later in association with another materia medica—that of Dioskurides. The manuscript, which has so fortunately preserved for us this fragment of the herbal of Krateuas, is the most illustrious of all the early botanical codices. It was prepared in Constantinople about the year A.D. 512 for a noble lady, Juliana Anicia, the daughter of Flavius Anicius Olybrius, Emperor of the West. For the next thousand years or so it remained at Constantinople, where it suffered various vicissitudes; in 1569 the diplomatist Augier Busbecq, when on a diplomatic mission to that city from the Emperor Ferdinand I., found it in the hands of a Jew, and induced his royal master to buy it for a hundred ducats. For a long period it was one of the chief treasures of the Hofbibliothek at Vienna, but as a result of the War it is now transferred to St. Mark's Library at Venice. The codex includes a picture of Krateuas engaged in painting a mandrake, which is conveniently held up for his inspection by Epinoia, the Goddess of Intelligence, while Dioskurides sits by, writing an account of the plant.

The text of the manuscript contains, among other matter additional to Dioskurides, an account of the uses of eleven plants, avowedly taken from Krateuas; these descriptions are accompanied by excellent illustrations, which may reasonably be regarded as ultimately derived from the same author's pictures, and thus as dating from about seventy-five years before the birth of Christ. Dr. Singer gives outline reproductions of these eleven pictures, from which we can gather an adequate impression of the essential character of the earliest of all illustrated herbals—the forerunner of the innumerable books with botanical pictures which have appeared in the two thousand years that have since elapsed. If we make allowance for the degradation which these drawings evidently suffered in the period of nearly six centuries which passed between their leaving the hand of Krateuas and appearing in the codex of Juliana Anicia, their qualities may well induce a sense of humiliation in the modern botanist; for their beauty and accuracy undermine the comfortable theory that the art of plant illustration has shown a progressive evolution. Indeed, it is not only on the artistic, but also on the medical side that degeneration rather than progress too often confronts the student of herbal literature as he passes the centuries in review.

Dr. Singer tells us that Andromachos of Crete, physician to Nero (A.D. 54–68), produced a modification of the *mithridate*, or panacea for all manner of poison, injury, and disease; and so late as the end of the eighteenth century, in certain continental cities it was still the custom to prepare once a year in public, in presence of the magistrates, a *Theriaca Andromachi*. The recipe of Andromachos himself included 45 items, while the eighteenth-century theriac had reached such absurd elaboration as to demand no less than 140 different ingredients! Though the theriac has died out under the wilting influence of modern scepticism, it has bequeathed to us the word 'treacle,' in which its memory survives as in an innocuous second childhood.

Andromachos was not the only Greek herbalist of the first century. Pamphilos, a physician who practised in Rome, had already written a book which appears to have been the first work on plants arranged in alphabetical order, and there were other writers of this period who dealt with vegetable drugs. All these herbalists are, however, entirely overshadowed in reputation by Pedanios Dioskurides of Anazarba, whose materia medica, which included about five hundred plants, was treated as the standard work for the next fifteen centuries—indeed in Arabic-speaking countries its influence survives even to the present day. Dioskurides, after studying in Alexandria and Tarsus, became physician to the Roman legions in Asia soon after the middle of the first century. His herbal shows an extensive knowledge of plants, but it does not reveal outstanding mental capacity or scientific insight. Attempts at the identification of the plants which he describes have occupied an astonishing amount of the time and energy of the botanists of later times; the difficulty of the task is due chiefly to the inadequacy of his descriptions, but in part also to the fact that even to-day the plants of Asia Minor have not been exhaustively explored. The authority attributed to Dioskurides led to the making of countless copies of his work, and the unravelling of the lineages of these various manuscript versions is a matter of the utmost difficulty and complexity. Dr. Singer gives a chart showing the results so far

[1] "The Herbal in Antiquity and its Transmission to Later Ages." By Charles Singer. (Reprinted from the *Journal of Hellenic Studies*, Vol. 47, Part I., 1927.) Pp. 52+10 plates.

attained regarding the relationships and sources of the different groups.

We have already referred to the codex of Juliana Anicia. It is a signal instance of the passion for copying, rather than for original observation of Nature, which possessed herbalists even so late as the Renaissance period, that fifteenth-century copies of the illustrations of this manuscript are known—that is to say, a botanical artist in the fourteen-hundreds was content to copy figures, some of which may have originated in the period before Christ, rather than to draw the flowers which were ready to his hand in his own countryside and garden. The same almost incredibly slavish and brainless copying characterised the text. The plant synonyms, which are a feature of the manuscripts of Dioskurides, were copied and re-copied right into the sixteenth century, though many of them were in strange tongues, which had been extinct for more than a thousand years. Dr. Singer lays stress upon the fact that the creative period of Greek science came to an end in the second century of the Christian era, and that, during the Dark and Middle Ages, the illustrated manuscript herbals are merely literary products, the preparation of which involved no genuine knowledge of plants.

The materia medica of Dioskurides was not the only work of its class which was widely circulated in the Middle Ages. An immensely popular herbal was that of Apuleius, which is supposed to date from a Greek original of the fourth century; it is frequently combined with a Latin version of Dioskurides. How the name of Apuleius became associated with it is not known; the author of "The Golden Ass" had no concern with it. As in the case of Dioskurides, Dr. Singer gives a diagram indicating the probable descent of the principal groups of manuscripts. This herbal is of special interest to us in Great Britain, since versions of it exist which are of Anglo-Saxon and Anglo-Norman workmanship.

In the fifteenth century the inventions of printing and of wood-engraving rendered possible a new era in herbal history, but at first there was a failure to realise the distinctive potentialities of these inventions, and the earliest printed herbals diverged little from the preceding manuscripts. Dr. Singer concludes his work by demonstrating the continuity of the printed herbal with the manuscript tradition which gave it birth. His lucid memoir, with its numerous and exquisite illustrations, should awaken further interest in a subject which is far from being exhausted, and still stands greatly in need of workers trained in the methods of critical scholarship.

Obituary.

Prof. D. Noël Paton, F.R.S.

THE death of Prof. Diarmid Noël Paton on Sept. 30 has removed an outstanding teacher of physiology, and a devoted investigator of the subject.

Noël Paton, the eldest son of Sir J. Noël Paton, the famous artist, was born in 1859. He was educated at Edinburgh Academy, where he had as classmates Herdman of Liverpool, D'Arcy Thompson of St. Andrews, and Haldane of Oxford. It is no wonder that when he passed to the University of Edinburgh he joined the Faculty of Science. He inclined at first towards zoology, then to botany, but having begun the study of medicine he found his real interest. After a distinguished undergraduate career he proceeded to Vienna for a short period of post-graduate medical work, and on his return to Edinburgh commenced general practice. He was offered and accepted a biological fellowship in the University of Edinburgh, and two years later, in 1886, he was appointed lecturer in physiology at Surgeons' Hall. He was able to devote his whole time to research and teaching when, in 1889, he was appointed superintendent of the Research Laboratory of the Royal College of Physicians, Edinburgh. He continued hard at work in Edinburgh until 1906, when he was nominated by the King to the Regius professorship of physiology in the University of Glasgow.

Noël Paton may rightly be regarded as one of the last 'all round' physiological teachers in Britain. He had a very wide and deep knowledge of his subject. Much of his energy and enthusiasm was given to the conduct of his classes. He was a born teacher, and he expressed his views with clarity and thoroughness, being scrupulous to put before the student all sides of the problem under discussion. He believed intensely in his own interpretation of the facts, but he was insistent that the student should also make up his own mind. Even the appearance of laying down the one and only law was anathema to him. Throughout his course of physiology he never forgot that the majority of his hearers were going to be practitioners of medicine. He related as much as possible of his teaching to clinical work, often illustrating his points by the display of actual patients.

As a research worker Noël Paton was keen and energetic. He attacked his problem with a passionate devotion to the task, and he was unswerving in his endeavour to reach the truth. He had a horror of cheap and shoddy work. Any kind of special pleading, of the suppression of material facts or negative results, roused him to a righteous fury. His early research work was mainly devoted to chemical physiology; he was, indeed, one of the first workers in Britain to investigate metabolic problems. Although until the end he was interested in the chemical aspects of physiology, yet, as his own published work and that of those who worked under his direction show, his interest were wide and varied. This width of outlook conspicuous in two of his books, "The Regulator of Metabolism" and "The Continuity of Life." It did not matter to him if his ideas clashed with popular or commonly accepted opinion.

So far as individual pieces of laboratory research are concerned, probably the most valuable is

study of the parathyroids. Whether or no his conclusions stand the test of time, this work will always hold its place as one of the most complete and far-reaching studies of the subject. Nutrition always held a first place in his affections, and he was responsible for some of the most interesting dietary studies carried out in Britain. These studies culminated in the comprehensive study of child life done in conjunction with Prof. L. Findlay, and published as a Medical Research Council report under the title of "Poverty, Nutrition, and Growth."

Beneath a rather formal, sometimes aloof, but always graceful appearance, Noël Paton hid a very warm, sensitive, and kindly heart. It is perfectly true that he did not suffer fools gladly, but no case of real hardship left him unmoved. As a colleague he was always anxious and willing to allow full credit to his co-workers, and he contributed freely and generously of his experience. As Prof. Macneile Dixon said in his valedictory address at the graveside, "There were qualities in him, in that sensitive artist nature of his, shy and precious qualities, qualities he would fain have hidden, which did not make life easier for him, but which endeared him to his closer friends." These are true words. He lived for science. As he said himself on one occasion, the joy of sailing upon the ocean of discovery is to the man of science the real joy of life. But science was to him more than mere joy, it was a religion the teachings of which he accepted unfalteringly. His belief in and respect for these teachings ruled his life. E. P. C.

Prof. S. Oppenheim.

Samuel Oppenheim, professor of astronomy in the University of Vienna, died in that city on Aug. 15, in his seventy-first year. He had graduated at Vienna in 1880 in the subjects of mathematics, physics, and astronomy, and obtained the doctor's degree in 1884 with a thesis on a new method of integrating the equations of planetary theory. He was an observer at the University Observatory, Vienna, until 1889, when he moved to the Vienna-Ottakring Observatory, remaining there until 1896; he also took pupils in astronomy during this period. In 1896 he moved to Arnau, where he taught astronomy in a school; he went to Prague in a similar capacity in 1899, remaining there until 1911, when he was appointed professor at Vienna.

Oppenheim's interests were mainly in gravitational astronomy; he worked on the perturbations of asteroids, the problem of three bodies, and the distribution and motion of the stars. He wrote several encyclopædia articles on astronomical and gravitational subjects, and gained a high reputation as a teacher. His health began to fail last winter; he succeeded, though with difficulty, in attending the meeting of the Astronomische Gesellschaft at Heidelberg in July, but he died only four weeks after his return home.

For many of the above details we are indebted to an article by J. Rheden, of the University Observatory, Vienna, in *Astr. Nach.*, No. 5585.

Miss Jessie L. Weston.

The death is announced of Miss Jessie Laidlay Weston, D.Litt., which took place in London on Sept. 29 at the age of seventy-seven. Miss Weston was born on Dec. 29, 1850, and educated at Brighton, Paris, and Hildesheim, and studied art at the Crystal Palace School. In 1890, at the suggestion of the late Alfred Nutt, and with the view of making the stories of the Wagner dramas more widely known in England, she took up the study of the Arthurian Legend. Her first work was a translation of "Parzival," by Wolfram von Eschenbach, and this was followed by a series of studies of the origins and development of the Arthurian Cycle. She dealt in succession with Sir Gawain, Sir Lancelot du Lac, Sir Perceval, and "The Three Days' Tournament," her studies being published in the Grimm Library. Then followed "Seven Arthurian Romances Unrepresented in Malory," "Romance, Vision, and Satire," and "Chief Middle English Poets."

Miss Weston was a finished scholar and a sound and acute critic, with a breadth of interest that took her beyond the purely literary or textual aspects of her material. As was shown in her last published book, "From Ritual to Romance," which appeared in 1920, origins meant more to her than purely literary sources, bereft of their context of belief and custom. At the time of her death Miss Weston was engaged on a study of the origin of the French romance "Perlesvaux." In addition she was a contributor to the "Encyclopædia Britannica" and the "Cambridge History of English Literature," as well as the *Folklore Journal*, *Revue Celtique*, and other and specialist periodicals. In recognition of her services to Celtic literature, in 1923 she was made a D.Litt. of the University of Wales.

We regret to announce the following deaths:

Prof. R. A. Berry, professor of agricultural chemistry at the West of Scotland Agricultural College, Glasgow, on Oct. 12, aged fifty-two years.

Brigadier-General W. H. Bixby, formerly of the U.S. Army, a former president of the Mississippi River Commission, of the International Navigation Congress (1912), and of the Society for Testing Materials (1917), distinguished for his work on bridges, rivers, and harbours, on Sept. 29, aged seventy-eight years.

Prof. G. H. Bryan, F.R.S., formerly professor of pure and applied mathematics at University College, Bangor, and author of "Stability in Aviation," on Oct. 13, aged sixty-four years.

Prof. J. E. Kirkwood, head of the department of botany at the University of Montana, who worked on the botany of the Rocky Mountains region, on Aug. 16, aged fifty-six years.

Dr. David Murray, a distinguished student of the history and archæology of Glasgow, vice-president of the Society of Antiquaries of Scotland in 1900–3, and president in 1904–7 of the Royal Philosophical Society of Glasgow, on Oct. 2, aged eighty-six years.

Prof. A. H. Patterson, professor of physics and dean of the school of applied sciences in the University of North Carolina, known for work on high tension phenomena, aged fifty-eight years.

News and Views.

IT is not an infrequent practice nowadays to supply details respecting the centenaries and bicentenaries of famous men oftentimes considerably in advance of the precise dates when these events fall. This has happened with regard to Capt. James Cook, the two-hundredth anniversary of whose birth at Marton, Yorkshire, is on Oct. 27. A brief account of Capt. Cook's life and explorations appeared in our issue of Sept. 29, p. 484; the following references to his association with the Royal Society will be a fitting and timely supplement to that article. Of Cook's first voyage in the *Endeavour* (1768–71), Capt. Wharton, F.R.S.—remembered by those of an older generation as Hydrographer to the Admiralty—said that "it was to the English nation the most memorable voyage of discovery that has ever taken place"; and, on thinking over these significant words, we cannot in justice fail to link Cook's continuity of effort and outlook with the fortunate association during the voyage of Joseph Banks, F.R.S., and Dr. Solander.

AT the time of this voyage Capt. Cook was forty years of age; Banks was twenty-five (he had been elected into the fellowship of the Royal Society at twenty-three), was wealthy, willing to spend to the uttermost on equipment, and enthusiastic for the acquisition of knowledge relating to races of men and Nature's products. Solander had been the specially favoured pupil of Linnæus, the "much loved pupil." One can imagine the joy and satisfaction which held the leader upon the confirmation of their companionship. Sir Joseph Hooker, commenting thereon, has written: "It needs no reading between the lines of the great navigator's journal to discover his estimation of the ability of his companion (Banks), of the value of his researches, and of the importance of his active co-operation." Here it may be mentioned that Priestley was invited by Banks to join the expedition, but official objections prevailed against his wish. On the outward sailing the *Endeavour*, calling at Rio de Janeiro, met with a cold reception. A letter from Cook to Dr. Morton, Sec. R.S. (the original of which is in the possession of the Royal Society) records: "No one Gentleman in this Ship have been permitted to go ashore at this place, this unheard of Treatment has not only prevented Mr. Green and myself from making any Astronomical observations here, but Mr. Banks and Doctor Solander from Collecting any of the productions of this country." However, in spite of this trouble, Banks succeeded in landing, and in collecting no fewer than 316 plant specimens, a tribute to his tenacity of purpose.

SIR ARCHIBALD GEIKIE, in his book on the Royal Society Club, notes that Capt. Cook, fresh from his great voyage, universally hailed, dined with the Club on Nov. 21, 1771, on the invitation of Dr. Maskelyne, and in the following week as the guest of Banks. Again, that the navigator dined with the Club eight times in the first half of the year 1776. The news of the massacre of Cook reached England in 1779. With the object of perpetuating his services and memory the Royal Society instituted a medal, which was struck in gold, silver, and bronze. The principal artists of the day had submitted designs, and one by Lewis Pingo, chief engraver to the Royal Mint, was adopted. The obverse bears the bust of Cook in naval dress; the reverse a representation of Britannia pointing to the south pole of a globe. The legend reads: "Our people have left nothing unattempted." King George III., the King of France, and the Empress of Russia received gold impressions. A gold example (now in the British Museum) was given to Cook's widow, and one to Benjamin Franklin. Banks, writing to the latter, refers to "those liberal sentiments which inclined you, upon Cook's return to Europe unexpected, to issue your orders to such American cruisers as were there under your direction, to abstain from molesting that great navigator." There is a portrait of Cook in the National Portrait Gallery by John Webber, R.A., a painting dated 1766, artist unknown, and a marble bust, attributed to one Le Vieux; a bronze statue of Cook stands in the Mall near the Admiralty Arch.

ON Oct. 31 occurs the centenary of the birth of Sir Joseph Wilson Swan, who was born in Sunderland in 1828 and died at Warlingham, Surrey, on May 27, 1914. Apprenticed to a firm of chemists at Sunderland, he afterwards became a successful chemical manufacturer and an eminent original investigator, and was widely known for his introduction of the carbon process in photography, his invention of bromide printing paper, and the introduction of the Swan incandescent electric lamp. So early as 1860 he produced slender carbon filaments of sufficient strength, elasticity, and conducting power to serve as light-giving material *in vacuo* for incandescent lamps, but he first exhibited such a lamp at a lecture in Newcastle in 1879. The following year, on Nov. 20, 1880, he lit the rooms of the Literary and Philosophical Society of Newcastle by means of such lights, and this was the first public lighting of a hall with his lamps. Swan was elected a fellow of the Royal Society in 1894, served as president of the Institution of Electrical Engineers, the Society of Chemical Industry, and of the Faraday Society, and received the Hughes and Albert medals for his work on the incandescent lamp.

NEWS has been received that the members of the British Association Expedition to the Great Barrier Reef have established their camp on the Low Islands near Cairns. Their personnel has been increased by five Australian naturalists, and Mrs. Stephenson has been appointed a member of the expedition, so that the party numbers seventeen. They are housed in three laboratory and living huts with outbuildings, while the lighthouse keepers have given hospitality to instruments of precision. For labour they have aborigin[illegible] or half-caste boys, who seem to be satisfactory. Th[illegible] equipment arrived in good condition, and the [illegible]tralian Navy, the Amalgamated Wireless, and th[illegible] Bureau of Meteorology have completed this b[illegible]

loan of instruments. A tide gauge has been erected and rafts put out for collecting and observing animals. Mr. Wishart has placed himself and his boat, a 38-feet ketch with 15 h.p. Kelvin engine, at their disposal on reasonable terms, and regular plankton and hydrographic stations are being taken, though the South-East Trades make work difficult. A smaller boat has been bought for lagoon and shore work. For deep sea work, if funds can be obtained, it is proposed to hire a larger vessel which plies in neighbouring waters. Profs. Richards and Goddard are expected to visit the party in November.

LOW ISLANDS seem to have been well chosen. They are half-way, seven miles, between the inner barrier and Port Douglas. There is good anchorage on the north of the island. There are two islands, that on which the camp is situated being of sand and 250 yards in diameter; the other is a very dense mangrove swamp. They are connected with a great area of flat reef, and are about ¾ mile apart. The reef is edged with a low boulder zone, inside which are a series of shallow lagoons rich in life. At spring tides the surrounding coral growth is of great richness and variety. Messrs. Russell, Orr, and Marshall are working the boat stations, while Dr. Stephenson has marked off areas of reef for intensive study. Mr. Moorhouse, of the University of Brisbane, has started a Trochus farm. Dr. Tandy is collecting and observing the Algæ. Dr. Yonge, with Mr. Nicholls of the University of Western Australia, is studying corals from the point of view of symbiotic Algæ and feeding. Mr. Otter is working on the bionomics of boring organisms and the effect of such on the breaking up of reefs. All are in good health, and the whole work seems to be going smoothly. The party is enthusiastic in respect to its reception in Australia.

SIR ARTHUR KEITH, in a presidential address on the racial frontiers of Britain, delivered to a scientific society at University College, Aberystwyth, on Oct. 16, traversed the orthodox view of historians which explains our racial frontiers by a theory of successive racial waves from east to west. This theory is based upon the conception that racial migration into Great Britain was by way of the east coast from the Continent. Sir Arthur, however, expressed his adherence to the view which has been gaining ground steadily during the present century, that we have also to look to the west, where there is evidence for an infiltration of peoples who reached Britain from the sea for at least 2000 years before Christ. As is shown by the distribution of megalithic monuments, Mediterranean peoples in succession reached Spain, crossed France to Brittany, and then passed onwards to the south and west of England, to Wales, the coastal lands of Ireland, the Atlantic seaward of Scotland as far as the Orkneys. On the other hand, the eastern side was invaded by the Beaker folk, and this North Sea invasion was mainly confined to lands which afterwards became settled by Saxons. The penetration of the Celtic-speaking peoples to the Mediterranean people of the west, he inferred, was largely peaceful, and imposed its language upon them. When, later, Britain was colonised by the Saxons, Wales alone was the only part of the ancient racial divide of Britain which persisted as a sharply marked line.

THE inaugural address for the 1928–29 session of the Biochemical Society, University of Birmingham, was delivered on Oct. 18 by Prof. S. B. Schryver, of the Imperial College of Science and Technology, London, who discussed some aspects of the chemistry of the proteins. He dealt mainly with the method of separating the products of hydrolysis of the proteins, showing that the 'esterification' method introduced by Emil Fischer is inadequate. He then described the 'carbamate' method, which consists in converting the amino-acids into the barium salts of their carbimates. During the course of this work three hitherto unknown products of hydrolysis have been discovered, namely, hydroxylysine, hydroxyamino-butyric acid, and hydroxyvaline. Attention was directed to the fact that for nearly every amino-acid found amongst the hydrolysis products, the corresponding hydroxy-acid has also been found. There is, however, one important exception, namely, leucine; in an attempt to isolate hydroxyleucine, a new base with eight carbon atoms has been discovered, to which the name protoctine has been given. Another method more convenient than the 'carbamate' method for separation of the products of hydrolysis has given still more satisfactory results, leading to the isolation of one more hitherto unknown product, the nature of which has not yet been finally determined. The essential feature of this second method is the separation of the copper salts into three fractions. In conclusion, Prof. Schryver suggested that the peptide structure of the proteins, suggested by Fischer, only accounts for the mere skeleton of the protein molecule. The proteins contain active peripheral groups, and readily undergo intramolecular changes. The presence and action of these peripheral groups may possibly account for the intense physiological activity displayed by the proteins.

THE Annual Report of the Meteorological Office for the year ending Mar. 31, 1928, directs attention to the expanding work of this department. Meteorological data for the British Isles are now obtained from 343 stations, of which 23 are maintained by the staff of the office, 28 are chiefly coastguard and lighthouse stations, 23 are known as 'crop-weather stations,' and are in certain agricultural colleges and research institutions, and 267 are private stations taking observations only once a day. In addition, there are nearly five thousand stations supplying records of rainfall only. The report notifies certain changes in the publications of the office. The *Weekly Weather Report* has ceased and is to be replaced by an annual volume which will contain data by calendar weeks both for stations and districts as heretofore, but the number of stations will be reduced to five for each district. In the *Monthly Weather Report* the records of a number of stations, where many occur close together, have been omitted as unnecessary in representing the meteorological conditions of the country. In "British Rainfall," the practice of giving the falls in millimetres as well

as inches has been discontinued, and the space sa ed in the tables has been used for the figure of he average annual rainfall in inches. In the forec t-ing department arrangements have been made to warn the public and a number of authorities w n weather conditions appear likely to cause high ti es in the Thames. This will give ample warning of floods.

IN "Disembodied Spirits" (Ipswich: The Anci nt House Press. 6d.) Mr. Reid Moir has contribute a vigorous attack upon the methods of modern i -vestigators of spiritualism. Briefly tracing the histo y of man's belief in ghosts, he points out that t e common appeal to the verdict of certain well-know n men is merely slavish homage to authority, sin e science has no more relationship to spiritualism s now conducted than engineering has to poult y breeding. Indeed, he adds, it is difficult to imagi e any subject more clearly divorced from scienti c method and research. Continuing, Mr. Reid M r suggests that the hypothesis of spirit interference s the least probable of all the hypotheses, and th t when competent and critical investigation is pe -mitted, it may be found that the modern belief n ghosts is as baseless as many other of the happi y forgotten fancies associated with the early develo -ment of mankind.

THE United States Department of Agriculture h pressed the aeroplane into service in the exploratic it continually carries on for new varieties of plan that may be of value if brought under cultivatio Dr. D. W. Brandes has recently returned from th interior of New Guinea, where he has been using th method to hunt for new varieties of sugar can 171 distinct varieties of cane were secured, one them a species described as new to science. Cc lected by this rapid method of transport, the can are being brought back alive, and will be put under cultivation in suitable regions in the United States They can then be used for purposes of hybridisation and examined as to their possibilities of disease resistance.

THE flourishing condition of the Botanical Society and Exchange Club of the British Isles is indicated by the Report for 1927, edited by the secretary, Dr G. C. Druce. In addition to notes and records of interest to British botanists, a number of papers are contributed by various authors. Those of most general importance deal with the flora of St. Kilda, the adventive flora of the Metropolitan area, British plants contained in the Du Bois Herbarium at Oxford, 1690–1723, some English *Alchemillas*, phenological observations made at Oxford, and a visit to the Canaries. Under the heading of "Personalia and Various Notes" we are pleased to note a commenda-tion of the scheme for a series of transplant experi-ments undertaken by the British Ecological Society at the suggestion of the Director of the Royal Botanic Gardens, Kew. As the editor of the report states "it is mainly by comparative cultures of authentic-ally named plants that their true grades car ascertained."

THE Russian Academy of Sciences Commission fc the Study of Nationalities of Russia has begun th publication of a new quarterly, under the titl *Chelovek* (Man). The first part for 1928 contains a editorial defining the aims of the journal, as a mediur for publishing original works and reviews of literatur on all problems connected with the study of man fror the bio-anthropological point of view. Amongst th contents of the first part may be noticed an interestin paper by J. A. Philiptchenko on recent investigatior of the problem of inheritance of genius, partly base on the author's own research amongst families of som famous Russian men of science. N. A. Podkopae gives a very concise account of the problem of cor ditioned reflexes, as studied by Pavlov and his schoo A review of results achieved in the study of palæ lithic man in Russia is presented by P. P. Efimenk while L. S. Berg contributes a most useful list of th ethnographical maps published in Russia since th seventeenth century. A very important section of th new publication is that containing records of currer events in the study of ethnography and anthropolog in this section many useful and interesting data on th organisation and work of various Russian institutior and expeditions are included.

BEGINNING in July last, the Bureau of Standards Washington is sponsoring a new monthly *Journal Research* which will replace the well-known series *Scientific Papers* and *Technologic Papers* which up now have been published under the auspices of th Bureau. The new journal will in future be the offici medium for the publication of original papers from th Bureau of Standards, whether on pure or applic science, together with critical reviews on science ar technology. The size of page is approximately that the *Philosophical Magazine*. There are to be two v-umes a year, obtainable at an annual subscription 2·75 dollars in N. America and 3·50 dollars elsewher from the Superintendent of Documents, Governme Printing Office, Washington, D.C., U.S.A. It may noted that reprints of individual papers will also purchasable. The July issue of the *Journal of R search* contains 104 pages and several plates devoted five different papers covering subjects as wide apart reflectometry, interferometry, tread-movement a wear in pneumatic tyres, accelerated tests of pain varnishes, etc., and the chemical analysis of refractori There is, we think, no question that the new form publication adopted by the Bureau will be fou more generally convenient than the method formo adopted.

FROM *The Librarian and Book World* (Gravese we have received the new edition of "The Librar Museums, and Art Galleries Yearbook," corre to the end of 1927. A useful feature in this is index to collections of books dealing with spe subjects, such as agriculture, anthropology, a quities, archæology, down to weapons (savage), w and zoology. The alphabetical list of librarians curators should also be of service. The informat as to libraries under the head of each town is ractical. For the first time a selec the British Empire and foreign coun

is included. The scheme of the book is good, but mistakes and omissions are more than need be. Such obvious sources of information as the Telephone Directory, *Whitaker's Almanack*, and the *Museums Journal* would have enabled the editor to put many right. In future, he will have Sir Henry Miers' Report on Museums to the Carnegie Trustees and the ASLIB Directory so far as Great Britain is concerned. Still, for those who need such a work of reference, the book is worth the 25 shillings asked.

THE issue of the *Journal of the Franklin Institute* for June contains a 60-page report of the work being done at present under the Bartol Research Foundation. It is a reproduction of the address of the Director of the Foundation, Dr. W. F. G. Swann, to the Franklin Institute on Mar. 15 last. In it the nine or ten investigations which are being carried out are described in such a way that the nature of the problem each is intended to solve, the method of attack, and the nature of the results obtained up to the present, are quite clear to a reader not necessarily a specialist in the subject concerned. Details of experiments are omitted as the concern of the specialist only, and the whole report forms interesting reading. The principal researches are on the cosmic radiation, X-rays, the reflection of hydrogen atoms from the surfaces of crystals, the nature of the electric arc between metallic electrodes, thermionics, the dielectric constants and electrical conductivities of salt solutions, the passage of light through sodium vapour, and the possibility of producing a magnetic field by rotating a conductor. This form of report, of interest to the general reader, seems to us well worthy of imitation.

RAVITY observations from a submarine were taken some years ago by Dr. Vening Meinesz on a journey between Holland and Java on a Dutch vessel. Using the same apparatus, Dr. Meinesz was leaving New York in October on an American submarine for a cruise in the Caribbean Sea and Gulf Mexico. A recent *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., reports that he was to be accompanied by Dr. F. E. Wright, of the Carnegie Institution Geophysical Laboratory. The course of the submarine is to be made to cross the deepest waters in the West Indies in order that observations of the force of gravity may be made where the earth's crust is farthest removed from the sea-level. The cruise is expected to last for several months.

No. 1, Vol. 28 of *Natural History*, that most attractive popular journal of the American Museum of Natural History, is devoted entirely to fishes. The urteen articles cover a wide range of interest, and, s is usual with this journal, they are accompanied by dmirable illustrations, several of which are in colours. glers will find much to interest them in this number. r. Zane Grey describes the results of two remarkable hing expeditions in New Zealand waters in 1926 and '27. Among the record catches mentioned are: a ck marlin (*Makaira marlina*) of 976 lb.; a striped rlin (*Marlina mitsukurii*) of 450 lb.; a yellowtail (*Seriola dorsalis*) of 111 lb.; a thresher shark (*Alopias vulpes*) of 640 lb., the largest ever taken on rod and reel; and a broad-bill swordfish of 400 lb., the first *Ziphias gladius* ever caught with rod and reel in New Zealand waters. Another article deals with the Zane Grey Game Fish Collection in the Hall of Fishes in the American Museum, which includes many of Mr. Grey's most notable sporting catches. Van Campen Heilner describes his experiences in catching the bonefish (*Albula vulpes*), which he considers "the gamiest fish of any size or species in either fresh or salt water that an angler can hope to take." By way of contrast, there is an interesting description of the primitive lines, hooks, and sinkers used by native fishers for the oilfish (*Ruvettus pretiosus*) in deep water, where the bottom may be reached at say 400 fathoms. Those readers more interested in general natural history are also well catered for. Mention must also be made of a general article by Dr. W. K. Gregory, which takes the form of a tour of the new Hall of Fishes of the American Museum. Judging from the illustrations given in this article, the new exhibit should prove a highly attractive one.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Monday, Oct. 22, the following officers were elected:—*President:* Sir Alfred Ewing; *Vice-Presidents:* Dr. James Currie, Dr. A. Crichton Mitchell, Prof. W. C. McIntosh, Sir Robert W. Philip, Prof. J. Graham Kerr, and Prof. W. Wright Smith; *General Secretary:* Prof. R. A. Sampson; *Secretaries to Ordinary Meetings:* Prof. C. G. Darwin and Dr. James Ritchie; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Prof. D'Arcy Thompson; *Council:* Prof. Richard Stanfield, Dr. A. Logan Turner, Dr. G. W. Tyrrell, Prof. J. H. Ashworth, The Hon. Lord Constable, Prof. E. Taylor Jones, Mr. J. B. Clark, Prof. F. A. E. Crew, Prof. J. Montagu F. Drummond, Mr. D. A. Stevenson, Prof. H. W. Turnbull, and Sir James Walker.

THE Council of the Institution of Civil Engineers has recently made the following awards for session 1927–28 in respect of selected engineering papers, published without discussion: A Telford Premium and an Indian Premium to Mr. F. C. Griffin (Calcutta); Telford Premiums to Messrs. R. A. Inglis (Buenos Aires), A. C. Vivian (Abadan, Persian Gulf), H. Herrod (Southsea), G. Parker (Cairo), and A. O. W. D. Pinson (Cairo); and in respect of papers read at students' meetings in London or by students before meetings or local associations during the same session: The James Forrest Medal and a Miller Prize to Mr. G. L. Goulden (Manchester); and Miller Prizes to Messrs. A. J. P. Pashlar (Birmingham), W. T. Shaddock (Barnstaple), E. C. Cookson (London), W. H. G. Mercer (Manchester), C. O. L. Gibbons (Stourbridge), E. M. Richardson (Manchester), J. S. Robertson (Glasgow), and S. N. Kelly (Glasgow).

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include one assistant conservator of forests, Mr. I. R. Dale to Kenya Colony, and two veterinary appointments, Major H. Greenfield to be veterinary

surgeon, Barbados, and Mr. R. S. Marshall to be assistant veterinary pathologist, Nigeria. There are four appointments to agricultural departments: Mr. R. M. Davies to be Superintendent, Agricultural Department, Nigeria, Mr. J. D. Broatch and Mr. C. L. Skidmore to be assistant superintendents of agriculture, Gold Coast, and Mr. J. E. Bruce to be a district agricultural officer, Tanganyika Territory. The three last named were holders of colonial agricultural scholarships. Mr. G. G. Auchinleck, who was appointed deputy director of agriculture, Gold Coast, from Ceylon in 1925, now succeeds Mr. C. H. Knowles, who retires from the post of Director of Agriculture, Gold Coast.

THE nineteenth Annual Exhibition of Electrical, Optical, and other Physical Apparatus is to be held by the Physical Society and the Optical Society on Jan. 8, 9, and 10, at the Imperial College of Science and Technology, South Kensington. As on previous occasions, the Exhibition will be divided into a Trade Section, comprising the exhibits of manufacturing firms, and a Research and Experimental Section. The Exhibition Committee invites offers from research laboratories and institutions, and from individual research workers, of exhibits suitable for inclusion in the Research and Experimental Section. The exhibits in this section will be arranged in three groups: (*a*) Exhibits illustrating the results of recent physical research; (*b*) lecture experiments in physics; (*c*) historical exhibits in physics. Offers of exhibits for these three groups should be communicated immediately, and in any case not later than Nov. 14, to the Secretary, Physical and Optical Societies, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

A REVIEW of the work of the Rockefeller Foundation for 1927, by its president, Dr. George E. Vincent, has been issued. The total disbursements for the year amounted to 11,223,124 dollars. This includes a sum of two million dollars towards a site for the University of London. The remainder has been expended in promoting public health organisations and nursing training schools in many lands, in grants to departments of schools of public health and biology, in the provision of 864 fellowships for study and research in preventive medicine, in a grant towards the publication of *Biological Abstracts*, in a contribution to the Health Organisation of the League of Nations, and in many minor appropriations for promoting human welfare.

THE *Quarterly Review of Biology*, published by The Williams and Wilkins Company, Baltimore, U.S.A. (the English agents being Baillière, Tindall and Cox), is one of the liveliest of biological publications. Its book notices are characterised by their downright opinions as well as by their caustic humour, and the main articles are valuable contributions, particularly directed towards the elucidation of general biological problems. In the June number, Prof. John Tait writes on "Homology, Analogy, and Plasis," Remington Kellogg concludes his articles on the adaptation of whales to life in the water, R. M. Oslund discusses "Seasonal Modifications in Testes of Vertebrates," and Raymond Pearl's "Evolution and Mortality" has already been noticed amongst our Research Items. There are other equally important discussions, but the above gives a fair indication of the scope and interest of the number.

A LIST of life-saving stations of the world, now in its second and much revised edition, is published by the International Hydrographic Bureau as *Publication 18* (price 30 cents). It gives the name, latitude, and longitude and kind of apparatus kept at every station in the world. The text is in both English and French, and the Bureau gives full permission to anyone to reproduce the work in any other language. The most noticeable feature is the long list of countries on the coasts of which there are no live-saving stations. This is intelligible in certain lands which are off the track of shipping or in others which are still under the control of unprogressive governments, but it is surprising in the case of such countries as Newfoundland, Burma, and India (except Karachi), Jamaica, Cuba, Tasmania, and the whole of Africa except Algeria, Tunis, and the Union of South Africa.

A LIST of classified geological photographs, arranged under subjects, has been compiled from the set of photographs taken by officers of the Geological Survey during the last thirty years in the course of their work in Great Britain. The complete set, numbering above 7000, is preserved in albums deposited in the libraries of the Survey and Museum at 28 Jermyn Street, and at the Scottish Office, 19 Grange Terrace, Edinburgh. The present list, which occupies 80 pages, has been prepared to help teachers, and the public in general, to make a suitable and rapid selection of the more interesting and striking photographs. Prints and lantern slides are supplied to order at reasonable prices, and, as shown by actual experience, within a reasonable time. Copies of this most useful and trustworthy publication are obtainable at a shilling each from H.M. Stationery Office (Adastral House, Kingsway, W.C.2; York Street, Manchester; 120 George Street, Edinburgh; or 1 St. Andrew's Crescent, Cardiff).

WE have received the annual report for 1927–28 of the National Institute for the Blind (224 Great Portland Street, London, W.1). The work of the Institute is surveyed and the activities of the blind are depicted in a number of illustrations. A research committee is constantly engaged in perfecting existing, and seeking new, methods for minimising the hardships of blindness by mechanical means. The production of literature in Braille and Moon type forms are important branch of the work of the Institute, and during the year nearly 18,000 bo[...] volumes in Braille were issued, including sever[...] works on scientific subjects. The Institute may [...] helped not only by monetary contributions but als[o] by volunteer workers for the production of [...] books, etc.

THE University of Columbia has recently publishe[d] the Chandler Lecture delivered by Prof. M. Gomb[...] on the occasion of the presentation to him of

Chandler gold medal in December 1927. Prof. Gomberg is well known for his work on free radicals and tri-valent carbon, and his lecture took the form of a review entitled "Radicals in Chemistry, Past and Present."

MESSRS. Galloway and Porter, Ltd., Cambridge, have just issued a catalogue (No. 163) of upwards of a thousand works on mathematical and physical science offered for sale by them. The prices asked appear very reasonable. The catalogue contains as an addendum particulars of a number of pamphlets on the same subjects, many out of print and not easily obtainable.

IN the autumn announcement list of Messrs. Methuen and Co., Ltd., we notice the following forthcoming books of science: "The Great Chemists," Dr. E. J. Holmyard; "Mine Ventilation: The Generation of the Air Current," Prof. H. Briggs; "X-rays," Dr. B. L. Worsnop; "The Applications of Interferometry," W. E. Williams; "Wireless," J. A. Ratcliffe; "Mechanical Aptitude: Its Existence, Nature, and Measurement," Dr. J. W. Cox; "Psychology and Modern Materialism," Prof. W. McDougall; "Psychology as Science: Its Problems and Points of View," H. P. Weld; and "The Desert Road to Turkestan," O. Lattimore.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master for chemistry and physics in the Wimbledon Junior Technical School for Boys—The Principal, Technical Institute, Gladstone Road, S.W.19 (Nov. 2). An Ackroyd memorial research fellow for textile industries in the University of Leeds—The Clerk to the Senate, University of Leeds (Nov. 3). A demonstrator in agricultural botany in the Department of Botany, the University, Leeds—The Registrar, The University, Leeds (Nov. 12). A professor of physiology at the King Edward Medical College, Lahore—The Inspector-General of Civil Hospitals, Punjab, Lahore (Dec. 1). A junior assistant under the Directorate of Ballistics Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant lecturer in physical chemistry in the University of Leeds—The Registrar, The University, Leeds.

Our Astronomical Column.

THE ROTATION PERIOD OF NEPTUNE.—J. H. Moore and D. H. Menzel have investigated this period by the spectroscopic method, using the 36-inch refractor at Lick (*Pubs. Astr. Soc. Pacific*, August). They placed the slit parallel to the planet's equator, as lately determined by Eichelberger and Newton from the shift in the node of the satellite; their deduced position for the planet's north pole was R.A. 295°·2, N.Decl. 41°·3, equinox 1900·0.

Seven spectrograms were obtained between Feb. 17 and May 30, 1928. They all showed the spectral lines inclined in the same sense, and gave 2·76 ± 0·15 km./sec. as the linear speed of a point on the equator. Taking the circumference of Neptune's equator as 157,000 km., they deduce 15·8 hours as the rotation period, with a probable error of 1 hour. This result makes it probable that the values $7^h\ 55^m\ 12^s$, and $7^h\ 50^m\ 6^s$ found by Maxwell Hall in 1883 and 1915 respectively, and those found a few years ago by Opik and Liviander at Tartu, $7^h\ 42^m\ 24^s\cdot1$ and $7^h\ 50^m\ 10^s\cdot7$, were really the half period. The latter were found by periodic variation in the planet's light; if opposite hemispheres happened to resemble each other, the light would vary in half the rotation period. Twice the mean of the four values is $15^h\ 38^m\ 56^s\cdot4$, which is very close to the new value. The longer value is supported by dynamical considerations, Dr. J. Jackson having shown, in *Mon. Not. Roy. Ast. Soc.* for March 1926, that the 7-hour period would imply a degree of oblateness in the planet much greater than that indicated by the shift of the node of the satellite. He found a period of 19·1 hours, but with a probable error of nearly a fifth of itself, so that the new value is not too discordant from it. The most surprising result of the new investigation is that the rotation of Neptune is direct, that is, in the same direction as the earth, and the opposite direction to the revolution of the satellite. The seven spectrograms are all in agreement on this point. In all other cases in the solar system, except the very remote outer satellites of Jupiter and Saturn, rotation and satellite movement are in the same sense. Moore and Menzel found that the shift in latitude 45° was $\frac{1}{5}$ of that at the equator, while that at the poles was almost zero; these results support the correctness of the assumed position of the planet's equator.

PHOTOGRAPHS OF VENUS.—The photography of Venus in light of different wave-lengths was undertaken by Mr. F. E. Ross during a very favourable elongation in June–July 1927, using the Mount Wilson 60-inch and 100-inch reflectors. A paper describing his results, and including a useful résumé of previous work on Venus (both photographic and visual), appears in a recent issue of the *Astrophysical Journal* (vol. 68, p. 57). Owing to the greater penetrating power of long waves, it was hoped that photographs taken by red or infra-red light might show some details of the true surface; it was found, however, that such photographs actually showed no detail, whereas many markings were clearly visible in photographs taken in ultra-violet light. The author suggests as a tentative explanation the existence of a very dense yellowish lower atmosphere above which lies a thin stratum of cirrus cloud. The ultra-violet photographs (which are well reproduced on two plates) show much variable detail, assumed to be due to atmospheric disturbances in the upper layers. The photographs appear to require a short rotation period, inconsistent with spectroscopic data, and a period of about 30 days is suggested as the best compromise which can be made at present from all existing data.

THE ORBIT OF μ' HERCULIS.—The work of E. Silbernagel on the orbit of ζ Herculis was recently mentioned in this column. He contributes a paper on μ' Herculis to *Astr. Nach.*, 5583. The observations used extend from 1857 to 1926, without any considerable gaps, and cover more than one and a half revolutions. The final period is 42·87 years, periastron 1879·42, semi-major axis 1·29″, eccentricity 0·183. A second solution, with slightly different values, represents the observations of distance somewhat better. Systematic corrections are determined for six of the observers.

Research Items.

BRONZE AGE AND LATER BURIALS AT DUNSTABLE.—A further report on the excavations of the University College (London) and the Hospital Anthropological Society at Dunstable on No. 5 Barrow, Five Knolls, appears in *Man* for September. The whole of the central area and a large part of the periphery of the mound have now been excavated down to the undisturbed chalk. Twelve secondary interments by inhumation were found, including a large multiple burial near the north-east margin of the barrow, making twenty-two superficial burials by inhumation on this site in all. The evidence points to the barrow having been erected in the Bronze Age. The primary burial contained a woman of neolithic type, while the urn containing cremation No. 1 was deposited in the Middle Bronze Age, and No. 2 probably dates from the latter period, though there is no evidence. It is likely that the barrow was used as a burial place in Saxon times. The superficial burials were all very near the surface, one being so little as three inches only below it. The archæological evidence for dating them is very scanty, but, accepting a coin as indicative of date, the end of the third century A.D. may be taken as the limiting date, but there is nothing to show how much later they may be. The careless method of burial suggests a place of execution. The disturbance after burial in many cases is probably recent. All the adult male skulls are large and muscular. One is dolichocephalic, six mesolicephalic, and four brachycephalic, the index ranging from 74·7 to 83. The average from the multiple burial is 79·9, and of the other male skulls 78·6. The average for the Saxon skulls in the London museums is 74·7, and it is therefore possible that the Dunstable skulls show signs of Alpine admixture. The jaw is larger and broader than the usual Saxon type, and the nasal index higher (average of 7 males, 50·6). On the other hand, the greater basiobregmatic and nasobasion length characteristic of the Saxon type is present, distinguishing it from the Iron Age and Romano-British type. The teeth are large and regular; two have an edge to edge bite. Seven adult males show caries.

OXYGEN AND CANCER.—Warburg and his collaborators have shown that malignant tissues differ from normal tissues in the character of their respiratory processes: the tumour cells obtain their energy chiefly from glycolysis with the consequent production of lactic acid, whereas in the respiration of normal cells oxygen is utilised and the end products of combustion are carbon dioxide and water. A normally growing cell also shows glycolytic activity, but the accompanying utilisation of oxygen suffices to break down the products of this activity into the ultimate end substances of oxidation. Warburg therefore suggests that the causative factor in the origin of tumours is deficiency of oxygen. Such a conclusion calls to mind that Mr. Lionel Cresswell put forward the same view so far back as the year 1914 (*Nineteenth Century and After*, May 1914) as the *Spectator* of Sept. 29 points out. He suggested that a variety of agents might be the immediate cause of a deficiency in the oxygen supply to a cell or group of cells, such as injury, senility, etc. If active nascent oxygen were supplied to these cells, presumably by means of some catalytic agent, they might be expected to seize on it avidly, and so increase their oxidative processes that the food supply reaching them by the usual channels becomes insufficient and they are led to prey upon their neighbours, which, being uninjured, are still suffering from lack of oxygen. Although in its details the hypothesis may not be completely borne out by the facts of experiment, yet the central idea of a lack of oxygen being the essential stimulus to the development by a cell of malignant characteristics appears confirmed by the work of Warburg. The corollary is that an adequate supply of oxygen to tumour cells should inhibit their disordered growth, and Wasels has found in mice that cure of malignant growths has followed the respiration of a mixture of oxygen and carbonic acid, accompanied by the injection of certain preparations of iron. It is possible that these observations may provide the explanation for certain cases of spontaneous cure of cancer which have been reported, as well as lead to an efficient therapeutics in the future.

TOHEROA SOUP.—Dr. John Malcolm in his paper "Food Values of New Zealand Fish, Part 9. Tinned Toheroa and Toheroa Soup" (*Trans. and Proc. New Zealand Institute*, vol. 59, pt. 1, March 1928) gives the results of an investigation of the food value of tinned Toheroa and Toheroa soup. The Toheroa (*Amphidesma ventricosum* Gray) is a bivalve mollusc living in the tideway of certain long sandy beaches, and has been recently successfully canned whole and forms the basis of 'Toheroa soup.' Experiments on feeding rats showed the mollusc to be rich in vitamin A. Similar work done on the Stewart Island oysters showed that, on the whole, the toheroas were the richer of the two, although both were valuable sources of this vitamin. The toheroa is apparently richer in chlorophyll, and it is thought this is probably due to its eating more phytoplankton, whilst the oyster eats more zooplankton.

NEW ZEALAND ALCYONARIANS.—In his paper "On Some Alcyonarians from New Zealand Waters" (*Trans. and Proc. New Zealand Institute*, vol. 59, pt. 1, March 1928) Dr. Benham describes five species, four of which are new. Only a few forms are known from these waters round the New Zealand coast, and the fauna of the deeper water apparently forms a new field for the zoologist. Of the species here described three belong to the order Alcyonacea, one to the Stolonifera, and one to the Pseudaxonia. *Clavularia thomsoni* sp. n. is attributed to this genus by the author with some hesitation, as it has many features in common with Verrill's *Anthopodium australe* growing on another Alcyonarian, *Primnoella australasiæ*. Unfortunately, no figure exists of this. *Clavularia thomsoni* is a small form which creeps over the surface of a simple coral, probably a species of *Caryophyllia*. The coral itself was covered with an encrusting sponge containing needle-like spicules and the alcyonarian polyps projected through the sponge. So densely are the polyps coated with their own spicules, which are elongated and knobbed, that the stolon is completely hidden. With the Alcyonaria a knowledge of the internal anatomy and form of spicules is essential, therefore comparison with the species of most of the older authorities, who named them from external features only, is difficult. In these descriptions full attention is given to these important points and clear text figures are included.

IDENTIFICATION AND CLASSIFICATION OF FISHES BY THEIR SCALES.—The interesting question of the usefulness of scale-characters for the identification and classification of fishes is dealt with by Miss E. B. Peabody in *University of Colorado Studies*, vol. 16, No. 2. A group of fishes, the sub-order Clupeoidei was chosen in which, besides clearly delimited species

there are certain species which have been classified now in one family and now in another by different taxonomists. An endeavour was made to ascertain what light on the relationship of the species could be derived from a study of the scale-patterns, and to determine whether the scales could help to decide the proper position of some of the fishes the indefinite relationships of which had been shown by their numerous changes from one family to another. Miss Peabody draws the general conclusion that scales have a diagnostic value and are distinctive of families and genera, but not always of species. Those families which have been clearly delimited by taxonomists on the evidence of the morphology of the entire fish and have not been subjected to subsequent changes of position by other workers, exhibit definite scale-characters which distinguish them from other families. On the other hand, in those groups the genera of which have been changed again and again by taxonomists, the scales reflect the indefiniteness of the family border-lines. The author rightly points out that if scales, convenient as they are for study, can yield results similar to those obtainable by the usual process, then their use in cases where the whole fish is not conveniently at hand or cannot be produced, as in palæontological work, is of importance.

BIOLOGICAL CONTROL OF WOOD-WASPS.—The accidental introduction into New Zealand of the injurious steel-blue wood-wasp *Sirex juvencus* has led to the study of the parasites of its close ally *S. cyaneus* in England. In the *Bulletin of Entomological Research*, vol. 19, part 1 (August 1928) Messrs. R. N. Chrystal and J. G. Myers describe the main features in the life-histories of the large Ichneumon *Rhyssa persuasoria* and the rare and aberrant Cynipid *Ibalia leucospoides*. They were fortunate in finding in Tubney Wood, near Oxford, which consists of a stand of larches and pines, a locality where the host and its parasites occurred in sufficient numbers to allow of regular observation. The method of oviposition of *Rhyssa* has long excited the interest of entomologists, doubt often being expressed as to the ability of the insect to penetrate solid wood with its long slender ovipositor. The authors fortunately are able definitely to answer this question and find that the insect can pierce, almost up to the hilt of the ovipositor, the soundest wood. The eggs, which are described for the first time, are laid in the burrows of almost or quite fully fed *Sirex* larvæ or the pupæ. They live as ectoparasites, and the whole life-cycle normally occupies one year. The *Ibalia* oviposits in the young *Sirex* larva just before or more rarely just after hatching, utilising the ovipositor bores of its host for the purpose. The larvæ of this parasite seem to live wholly within their hosts, and the life-cycle requires at least two years. Since the two parasites attack their host in very different stages of the latter, risk of superparasitism seems negligible, and it is suggested that both species be introduced into New Zealand as a measure against the wood-wasp *Sirex juvencus*.

RESEARCH ON MALTING BARLEY.—The Barley Research Scheme of the Institute of Brewing has as its objects the investigation of the influence of soil, season, and manure on the yield and quality of the barley, the study of new variations and the differentiation of malting barleys by chemical means. The gradual accumulation of a great mass of data during the five years of its existence has obscured a number of interesting generalisations that emerge from the results, and a recent careful analysis by Sir John Russell (*Jour. Inst. Brewing*, **34**, 436; 1928) provides a useful summary of the present position. The trials were all carried out with Plumage Archer seed and under the same system of manuring, and on average, 1 cwt. of ammonium sulphate increased the yield by about 6 bushels per acre, *i.e.* six times the increase produced by superphosphate or potassium sulphate. It seems, however, that phosphates, which cause the barley to ripen prematurely, may even produce a decrease in yield on light dry soils. The April rainfall determines whether the plant can take up its fertiliser, whilst rainfall in May and June governs the use to which the fertiliser can be put, and is detrimental when potash is used. Ammonium chloride is a better source of nitrogen than an equivalent amount of the sulphate, and produces a greater number of grains per acre although the number of grains per ear is unaltered. The actual extract and amount of nitrogen in the grain, however, are both governed principally by the soil and season, and from a consideration of the rainfall in May and June, and of the date of sowing, it should be possible to forecast the latter for a particular soil. Analyses showed that the nitrogen content varied directly with the diastatic power, and inversely with the carbohydrate content.

GREEN MANURING.—Green manures grown as cover crops vary considerably as regards the rate of accumulation of nitrates which follows their incorporation with the soil, a further variation depending upon the time of ploughing under, whether in spring or autumn. T. L. Lyon and B. D. Wilson (*Cornell Univ. Agric. Expt. Stat. Memoir*, 115) have grown vetch, rye, peas, oats, and buckwheat as cover crops for ten successive seasons on the same soil, and found that the accumulation of nitrogen during the fallow periods after turning in decreased progressively in the order given, vetch being the most effective. The advantage in this respect lay with those crops which were less advanced in growth at the time of ploughing under. Fall ploughing induced the highest soil content of nitrate nitrogen in the spring and early summer, and liming increased the accumulation, particularly with rye. During the ten years' period of experiment the soil of all plots lost in total nitrogen at the rate of 42 lb. nitrogen per acre with vetch, 217 lb. with rye, 380 lb. with peas, 382 lb. with oats, and 412 lb. with buckwheat, whereas a similar plot kept continuously under grass gained 415 lb. nitrogen per acre. The loss of total nitrogen was in inverse order to nitrate nitrogen content of the soil during the period when nitrates were highest. After the ten years all the plots were planted to maize one year and oats the next, and the combined yields of the two crops were in inverse order to the loss of total nitrogen in the soil. As a means of mitigating the loss of fertility indicated by these results, it is suggested that (1) the land be laid down to grass for a period of years, and (2) those legumes be cultivated which are most active in fixing nitrogen, for example, vetch, but not field peas.

IODINE FROM MARINE ALGÆ.—The re-establishment of an industry based on the utilisation of marine algæ would be of very great economic importance for the inhabitants of the west coast of Ireland. T. Dillon and E. F. Lavelle (*Econ. Proc. Roy. Dublin Soc.*, September) suggest a process whereby various products can be recovered, which is simple enough in its initial stages to be operated locally all the year round. The idea is to collect the seaweed, chiefly Laminariæ, in reservoirs exposed to the weather and to allow it to decay. The resulting liquid, rich in iodine, potash, and organic matter, would be drained off at intervals, concentrated locally, and dispatched to a central factory for final treatment. Small scale experiments, in which 31 kilograms of Laminariæ were allowed to decay in the open for seventeen weeks, showed that the bulk of the iodine present was ex-

tracted in that time, about 70 per cent of the mineral matter, and 29 per cent of the total solids. Very little nitrogen was obtained by this method. After nine months a certain proportion of seaweed remained incompletely decayed, and it is suggested that such residues could be dried during the summer months and utilised as fuel for the evaporation of the extracts.

DEFORMATION OF THE SEA-BED DURING EARTHQUAKES.—Messrs. T. Terada and S. Higasi have studied the deformation of the sea-bed in three recent Japanese earthquakes. In the Tango earthquake of 1927 (*Tokyo Imp. Acad. Proc.*, vol. 4, pp. 296-299; 1928), a comparison of soundings before and after the earthquake revealed a zone of depression (of more than 3 metres) parallel to the coast-line and at a distance of 1-3 km. from it, beyond which there was a broader zone of upheaval. In the Tajima earthquake of 1925 and the Kwanto earthquake of 1923 (*ibid.*, pp. 364-366), there was formed first a zone of depression, then a zone of upheaval, both parallel to the coast-line, succeeded by another area of depression. This tendency of the sea-bed to be deformed in alternate zones of depression and elevation parallel to the coast-line suggests, in the authors' opinion, that there is some essential difference in the structure of the earth's crust even between the land-area and the shallow shelf of the sea-bed.

ANCIENT VOLCANOES OF BURMA.—During the last four years Dr. H. L. Chhibber, of Rangoon, has published a long series of papers (in some cases in collaboration with others) dealing with the records of Tertiary volcanic activity in Burma. A convenient summary and map is now presented in the *Journal of the Burma Research Society* (vol. 17, p. 169, 1927). The volcanoes of Burma show a remarkable linear arrangement, but up to the present the erroneous idea of a single volcanic line has prevailed; actually, there are four main lines. The western line is connected with the Arakan Yomas and the Andaman Islands, and includes many serpentine intrusions. The eastern line lies on the Shan plateau, and another line lies close to the edge of the plateau: the rocks of these include rhyolites and basalts having Atlantic characters. Finally, there is the best-known central or Popa line of volcanoes, including the centres of Mt. Popa, Monywa, and Wuntho. Barren Island and Narcondam represent the seaward continuation of this line, which is everywhere characterised by dolerites or by basalts, andesites, and related rocks of Pacific types. Beginning in the late Cretaceous, activity has continued at intervals up to almost historical times. It is noted throughout the country that the volcanoes have broken through in or near valleys and have avoided ridges or hills.

THE GREAT WHIN SILL.—An important paper by Prof. A. Holmes and Dr. H. F. Harwood on the age and composition of the Whin Sill and the related dikes of the north of England, appears in the *Mineralogical Magazine* for September. The post-Westphalian dikes of the district may be classified by their orientations into two clearly defined series. One of these consists of quartz-dolerites of the Whin Sill type in late Carboniferous dikes running east and west or north of east, whereas the other consists of Tertiary tholeiite dikes running north of west towards Mull. The Whin Sill dikes fall into four echelons, the Holy Island, High Green, St. Oswald's Chapel, and Hett systems. Chemical and mineral analyses of typical examples of each of these (and of the Wackerfield dyke to the south) prove that they and the Whin Sill are composed throughout of substantially identical material. It is shown that the magma-type is one of world-wide continental distribution, and that it is a nearly constant end-product towards which basaltic magma tends to differentiate under regional conditions. Under the central conditions of oceanic islands, differentiation follows a totally different course. The cooling history of the pyroxenes is worked out with special care, and the results are interpreted to indicate that some of the Tertiary dikes of Mull may represent a basaltic magma *diluted* with granitic magma rather than a residual magma produced by crystallisation-differentiation of the type advocated by Bowen. Prof. Holmes discusses the significance of his discovery of a pebble of the Whin Sill type of quartz-dolerite in the Upper Brockram near Appleby. This and other evidence leads him to conclude (*a*) that the intrusion of the Whin Sill and the related dikes followed closely on the Asturian phase of the Hercynian movements (between Westphalian and Stephanian); and (*b*) that the later mineralisation of the north of England (lead-zinc-fluorite-barytes, etc.) was associated with the Saalian movements (between Autunian and Saxonian). The injection of the Whin Sill and dikes is thus regarded as the closing act of the Upper Carboniferous in the north of England.

CRYSTALLOGRAPHIC TABLES.—The attention of mineralogists is directed to a useful publication by Victor Goldschmidt and S. G. Gordon, in which the determined crystallographic constants (angles and axial ratios) of all minerals are listed. The pamphlet is issued by the Academy of National Sciences of Philadelphia as *Special Publication No. 2*, 1928, at a price of 1.50 dollars. Details are tabulated for 1217 mineral species, and the chemical composition, specific gravity, hardness, cleavage, etc., are stated. The tables are based on the Goldschmidt two-dimensional gnomonic method and symbols, of which a brief explanation is given in the introduction.

A NEW MAGNETIC ALLOY.—The September issue of the *Journal of the Franklin Institute* contains an account by Mr. G. W. Elmen, of the Bell Telephone Laboratories, New York, of the magnetic properties of the new alloy 'Permivar,' of composition nickel 45 per cent, cobalt 25 per cent, and iron 30 per cent. When properly heat-treated, its magnetic permeability is initially double that of iron and is constant for fields up to 2 gauss. Its hysteresis loss per cubic centimetre per cycle for a magnetic induction of 100 gauss is only $2 \cdot 4 \times 10^{-5}$ ergs, while that of permalloy with 78 per cent of nickel is $3 \cdot 3 \times 10^{-2}$, and that of iron of the order of 1 erg. Slow cooling through the range of temperature 500°-400° C. and baking for a considerable time at 425° C. appear to be necessary for the development of the characteristic properties of the alloy, which is likely to prove of great value in the cores of loading coils for telephone circuits.

RADIO TIME SIGNALS.—The daily time signals transmitted by the radio stations at Rugby, Bordeaux, Nauen, and Annapolis are generally accepted by surveyors as accurate, for their errors rarely exceed one-tenth of a second. At the Conference of Empire Surveyors held last July, it was suggested that it would be useful to have published the corrections to Bordeaux, Nauen, and Annapolis, as determined at Greenwich. Corrections to the Rugby signal are published a month in arrear in the Admiralty *Notices to Mariners*. The *Geographical Journal* for October reports that the suggestion of the Conference has been adopted and that *Notices to Mariners* now contains the corrections. The greatest correction to Rugby during July was 0·04 s. and to Bordeaux 0·12 s., and the averages without regard to signs 0·019 s. are 0·039 s. respectively. The correction to Annapolis was uniformly positive with a mean of 0·074 s.

The Forest Industry of Finland.

IN a recent number (No. 8, 1928) of the *Oxford Forestry Memoirs*, Mr. W. E. Hiley discusses the "Forest Industry of Finland," his brochure being based on a visit to the Finnish forests last year. It has become a curious practice with some of the younger writers on forestry questions to treat pre-War investigations as either non-existent or of little importance. Thus in his paper Mr. Hiley writes: "Much has been written in the English language about Finnish forestry and the timber trade, and English readers can acquire a good general knowledge of these subjects without leaving Britain. But so far, very little information has been available with regard to the economics of Finnish forestry." Mr. Hiley does not define his term 'economics,' but a rusal of his interesting memoir fails to exhibit any arked departures from the lines of articles which peared in 1911 in the publications of the Geo-aphical Society of Finland. Several of these articles ere from the pens of experts such as Prof. A. K. ajander, P. W. Hannikaiven (then Director-General State Forests), and A. B. Helander (Inspector Forests). These articles were dealt with in the nglish press and in some cases by men who had a rsonal acquaintance with the Finnish forests.

Although, as Mr. Hiley says, the State forests of nland are mainly confined to the northern parts of e country, the richer and better forests to the uth being largely in private ownership, yet by 1910 e annual receipts from the State forests amounted £660,000 with an expenditure of £195,000. Under e Czarist regime, however, the policy towards nland was one of repression in industrial develop-ent, and the forest administration was starved. It ay be mentioned that the species consist principally Scots pine, spruce, and white birch, with a little pen, grey alder, and pedunculate oak.

Since 1917, when Finland freed herself from Russia, ere has been a remarkable progress in forest develop-ent and timber exploitation on up-to-date lines, ith the result that at the present time she is one our best suppliers of soft woods and has taken a ding place in the European timber markets. This velopment, and the startling rapidity with which has proceded, has proved of high interest to those quainted with the country and its pre-War position. r. Hiley has taken full advantage of the opportunities kindly afforded him by the Finnish Government officials, and his memoir will prove of value to all interested in this matter. It will suffice here to indicate some of the main divisions of his subject; namely, ownership of the forests, administration (State forests, joint stock company forests, private forests), sylviculture, felling and extraction, sawmills, economics of forest management, costs and prices, and finally a few remarks on the forest policy of Finland. The latter are of special interest, since the author here gives us the present-day forest policy of the Government.

The State recognises that its first duty is to maintain the timber increment (the forests providing the most important of Finnish exports) so as to preserve the great timber industry of the country, whilst maintaining the necessary supplies of wood for home consumption. In 1926 the value of timber and other forest products exported amounted to 85·4 per cent of all Finnish exports. As regards home consumption, all who have visited the country will have been struck by the universal use of timber. Outside the larger cities all buildings are almost entirely constructed of wood. It is estimated that 60 per cent of the wood felled is used in the country, representing a *per capita* consumption of 260 cub. ft. per annum, or about ten times more than the consumption in Britain. Wooden fences replace hedges, and the railway engines are of course fuelled with wood, coal being too expensive. The new policy in the State forests is to take an increasing share in the conversion of timber, whereas formerly the trees were sold standing, or felled and hauled to the rivers. The State now owns a controlling share in two important timber companies and has several sawmills of its own, including a large and modern mill at Veitsiluoto at the mouth of the Kemi River, in the extreme north of the Gulf of Bothnia.

The income from, and expenditure on, the State forests has increased progressively since the country became independent and a more rational policy was introduced, the figures for 1924 being respectively about nineteen and twenty-eight times the amounts for 1910. Some dissatisfaction is being manifested at the State entering into competition with the mercantile community; but in the present stage of this important industry in the country the policy would appear to be a sound one. In conclusion, Mr. Hiley's brochure may be commended as meriting a study by all interested in the soft wood timber trade.

Chemical Analysis in the Public Service.

'SAFEGUARDING'—in a non-political sense; safeguarding of health, of justice, and of revenue relies to an ever-increasing extent on the services hich can, under cautious yet confident direction, rendered by chemical science. The report of the overnment Chemist for the year ending Mar. 31, 928, abounds in examples of such service to the arious departments, and in certain respects to the overnment of Northern Ireland, the High Com-issioner for India, the Crown Agents for the Colonies, e Dominions Office, the Corporation of Trinity louse, the Commonwealth of Australia, and the High ommissioner for Southern Rhodesia. The work for ost of the departments is carried out at the laboratory Clement's Inn Passage, London; the laboratory at e Custom House naturally deals specially with stoms samples, some of which, together with excise nples, are examined at chemical stations estab-hed at the more important seaports. In addition, laboratory at the Geological Survey Museum maintained, and work for the War Office is performed at the Supply Reserve Depot laboratory at Deptford.

The total number of samples examined during the year was 491,039, an increase of 21,397 over that of the preceding year. In addition to this purely routine analysis—if such a term can be properly applied to so heterogeneous a collection of samples, involving the most varied and detailed methods of examination—a considerable amount of work has been done in connexion with the revision of existing methods and the investigation of new methods of detection and determination of substances; moreover, the Government Chemist (Sir Robert Robertson), his deputy, and staff serve on various official committees, and from time to time are called upon to give evidence in legal proceedings.

The report shows, for example, that exceptional care is necessary in the sampling of milk supplied in bottles, the absence of air space rendering mixing difficult; that forty samples of fresh milk in churns imported from the Continent were satisfactory; and

tracted in that time, about 70 per cent of the mineral matter, and 29 per cent of the total solids. Very little nitrogen was obtained by this method. After nine months a certain proportion of seaweed remained incompletely decayed, and it is suggested that such residues could be dried during the summer months and utilised as fuel for the evaporation of the extracts.

DEFORMATION OF THE SEA-BED DURING EARTHQUAKES.—Messrs. T. Terada and S. Higasi have studied the deformation of the sea-bed in three recent Japanese earthquakes. In the Tango earthquake of 1927 (*Tokyo Imp. Acad. Proc.*, vol. 4, pp. 296-299; 1928), a comparison of soundings before and after the earthquake revealed a zone of depression (of more than 3 metres) parallel to the coast-line and at a distance of 1-3 km. from it, beyond which there was a broader zone of upheaval. In the Tajima earthquake of 1925 and the Kwanto earthquake of 1923 (*ibid.*, pp. 364-366), there was formed first a zone of depression, then a zone of upheaval, both parallel to the coast-line, succeeded by another area of depression. This tendency of the sea-bed to be deformed in alternate zones of depression and elevation parallel to the coast-line suggests, in the authors' opinion, that there is some essential difference in the structure of the earth's crust even between the land-area and the shallow shelf of the sea-bed.

ANCIENT VOLCANOES OF BURMA.—During the last four years Dr. H. L. Chhibber, of Rangoon, has published a long series of papers (in some cases in collaboration with others) dealing with the records of Tertiary volcanic activity in Burma. A convenient summary and map is now presented in the *Journal of the Burma Research Society* (vol. 17, p. 169, 1927). The volcanoes of Burma show a remarkable linear arrangement, but up to the present the erroneous idea of a single volcanic line has prevailed; actually, there are four main lines. The western line is connected with the Arakan Yomas and the Andaman Islands, and includes many serpentine intrusions. The eastern line lies on the Shan plateau, and another line lies close to the edge of the plateau; the rocks of these include rhyolites and basalts having Atlantic characters. Finally, there is the best-known central or Popa line of volcanoes, including the centres of Mt. Popa, Monywa, and Wuntho. Barren Island and Narcondam represent the seaward continuation of this line, which is everywhere characterised by dolerites or by basalts, andesites, and related rocks of Pacific types. Beginning in the late Cretaceous, activity has continued at intervals up to almost historical times. It is noted throughout the country that the volcanoes have broken through in or near valleys and have avoided ridges or hills.

THE GREAT WHIN SILL.—An important paper by Prof. A. Holmes and Dr. H. F. Harwood on the age and composition of the Whin Sill and the related dikes of the north of England, appears in the *Mineralogical Magazine* for September. The post-Westphalian dikes of the district may be classified by their orientations into two clearly defined series. One of these consists of quartz-dolerites of the Whin Sill type in late Carboniferous dikes running east and west or north of east, whereas the other consists of Tertiary tholeiite dikes running north of west towards Mull. The Whin Sill dikes fall into four echelons, the Holy Island, High Green, St. Oswald's Chapel, and Hett systems. Chemical and mineral analyses of typical examples of each of these (and of the Wackerfield dyke to the south) prove that they and the Whin Sill are composed throughout of substantially identical material. It is shown that the magma-type is one of world-wide continental distribution, and that it is a nearly constant end-product towards which basaltic magma tends to differentiate under regional conditions. Under the central conditions of oceanic islands, differentiation follows a totally different course. The cooling history of the pyroxenes is worked out with special care, and the results are interpreted to indicate that some of the Tertiary dikes of Mull may represent a basaltic magma *diluted* with granitic magma rather than a residual magma produced by crystallisation-differentiation of the type advocated by Bowen. Prof. Holmes discusses the significance of his discovery of a pebble of the Whin Sill type of quartz-dolerite in the Upper Brockram near Appleby. This and other evidence leads him to conclude (*a*) that the intrusion of the Whin Sill and the related dikes followed closely on the Asturian phase of the Hercynian movements (between Westphalian and Stephanian); and (*b*) that the later mineralisation of the north of England (lead-zinc-fluorite-barytes, etc.) was associated with the Saalian movements (between Autunian and Saxonian). The injection of the Whin Sill and dikes is thus regarded as the closing act of the Upper Carboniferous in the north of England.

CRYSTALLOGRAPHIC TABLES.—The attention of mineralogists is directed to a useful publication by Victor Goldschmidt and S. G. Gordon, in which the determined crystallographic constants (angles and axial ratios) of all minerals are listed. The pamphlet is issued by the Academy of National Sciences of Philadelphia as *Special Publication No. 2*, 1928, at a price of 1.50 dollars. Details are tabulated for 1217 mineral species, and the chemical composition specific gravity, hardness, cleavage, etc., are stated. The tables are based on the Goldschmidt two-dimensional gnomonic method and symbols, of which a brief explanation is given in the introduction.

A NEW MAGNETIC ALLOY.—The September issu of the *Journal of the Franklin Institute* contains a account by Mr. G. W. Elmen, of the Bell Telephon Laboratories, New York, of the magnetic properties of the new alloy 'Permivar,' of composition nick 45 per cent, cobalt 25 per cent, and iron 30 per cen When properly heat-treated, its magnetic permeabilit is initially double that of iron and is constant for fiel up to 2 gauss. Its hysteresis loss per cubic centimet per cycle for a magnetic induction of 100 gauss is on $2 \cdot 4 \times 10^{-5}$ ergs, while that of permalloy with 78 per ce of nickel is $3 \cdot 3 \times 10^{-2}$, and that of iron of the order 1 erg. Slow cooling through the range of temperatu 500°-400° C. and baking for a considerable time 425° C. appear to be necessary for the development the characteristic properties of the alloy, which likely to prove of great value in the cores of loadi coils for telephone circuits.

RADIO TIME SIGNALS.—The daily time signals tra mitted by the radio stations at Rugby, Bordeau Nauen, and Annapolis are generally accepted by su veyors as accurate, for their errors rarely exceed o tenth of a second. At the Conference of Empire S veyors held last July, it was suggested that it wo be useful to have published the corrections to B deaux, Nauen, and Annapolis, as determined at Gre wich. Corrections to the Rugby signal are publisl a month in arrear in the Admiralty *Notices Mariners*. The *Geographical Journal* for October ports that the suggestion of the Conference has b adopted and that *Notices to Mariners* now cont the corrections. The greatest correction to Ru during July was 0·04 s. and to Bordeaux 0·12 s., the averages without regard to signs 0·019 s. 0·039 s. respectively. The correction to Annapolis uniformly positive with a mean of 0·074 s.

The Forest Industry of Finland.

IN a recent number (No. 8, 1928) of the *Oxford Forestry Memoirs*, Mr. W. E. Hiley discusses the "Forest Industry of Finland," his brochure being based on a visit to the Finnish forests last year. It has become a curious practice with some of the younger writers on forestry questions to treat pre-War investigations as either non-existent or of little importance. Thus in his paper Mr. Hiley writes: "Much has been written in the English language about Finnish forestry and the timber trade, and English readers can acquire a good general knowledge of these subjects without leaving Britain. But so far, very little information has been available with regard to the economics of Finnish forestry." Mr. Hiley does not define his term 'economics,' but a perusal of his interesting memoir fails to exhibit any marked departures from the lines of articles which appeared in 1911 in the publications of the Geographical Society of Finland. Several of these articles were from the pens of experts such as Prof. A. K. Kajander, P. W. Hannikaiven (then Director-General of State Forests), and A. B. Helander (Inspector of Forests). These articles were dealt with in the English press and in some cases by men who had a personal acquaintance with the Finnish forests.

Although, as Mr. Hiley says, the State forests of Finland are mainly confined to the northern parts of the country, the richer and better forests to the south being largely in private ownership, yet by 1910 the annual receipts from the State forests amounted to £660,000 with an expenditure of £195,000. Under the Czarist regime, however, the policy towards Finland was one of repression in industrial development, and the forest administration was starved. It may be mentioned that the species consist principally of Scots pine, spruce, and white birch, with a little aspen, grey alder, and pedunculate oak.

Since 1917, when Finland freed herself from Russia, there has been a remarkable progress in forest development and timber exploitation on up-to-date lines, with the result that at the present time she is one of our best suppliers of soft woods and has taken a leading place in the European timber markets. This development, and the startling rapidity with which it has proceeded, has proved of high interest to those acquainted with the country and its pre-War position. Mr. Hiley has taken full advantage of the opportunities so kindly afforded him by the Finnish Government officials, and his memoir will prove of value to all interested in this matter. It will suffice here to indicate some of the main divisions of his subject; namely, ownership of the forests, administration (State forests, joint stock company forests, private forests), sylviculture, felling and extraction, sawmills, economics of forest management, costs and prices, and finally a few remarks on the forest policy of Finland. The latter are of special interest, since the author here gives us the present-day forest policy of the Government.

The State recognises that its first duty is to maintain the timber increment (the forests providing the most important of Finnish exports) so as to preserve the great timber industry of the country, whilst maintaining the necessary supplies of wood for home consumption. In 1926 the value of timber and other forest products exported amounted to 85·4 per cent of all Finnish exports. As regards home consumption, all who have visited the country will have been struck by the universal use of timber. Outside the larger cities all buildings are almost entirely constructed of wood. It is estimated that 60 per cent of the wood felled is used in the country, representing a *per capita* consumption of 260 cub. ft. per annum, or about ten times more than the consumption in Britain. Wooden fences replace hedges, and the railway engines are of course fuelled with wood, coal being too expensive. The new policy in the State forests is to take an increasing share in the conversion of timber, whereas formerly the trees were sold standing, or felled and hauled to the rivers. The State now owns a controlling share in two important timber companies and has several sawmills of its own, including a large and modern mill at Veitsiluoto at the mouth of the Kemi River, in the extreme north of the Gulf of Bothnia.

The income from, and expenditure on, the State forests has increased progressively since the country became independent and a more rational policy was introduced, the figures for 1924 being respectively about nineteen and twenty-eight times the amounts for 1910. Some dissatisfaction is being manifested at the State entering into competition with the mercantile community; but in the present stage of this important industry in the country the policy would appear to be a sound one. In conclusion, Mr. Hiley's brochure may be commended as meriting a study by all interested in the soft wood timber trade.

Chemical Analysis in the Public Service.

'SAFEGUARDING'—in a non-political sense; safeguarding of health, of justice, and of revenue -relies to an ever-increasing extent on the services -hich can, under cautious yet confident direction, -e rendered by chemical science. The report of the -overnment Chemist for the year ending Mar. 31, -928, abounds in examples of such service to the -arious departments, and in certain respects to the -overnment of Northern Ireland, the High Com- -issioner for India, the Crown Agents for the Colonies, -he Dominions Office, the Corporation of Trinity -ouse, the Commonwealth of Australia, and the High -mmissioner for Southern Rhodesia. The work for -ost of the departments is carried out at the laboratory -Clement's Inn Passage, London; the laboratory at -e Custom House naturally deals specially with -toms samples, some of which, together with excise -ples, are examined at chemical stations estab- -lished at the more important seaports. In addition, -laboratory at the Geological Survey Museum -maintained, and work for the War Office is performed at the Supply Reserve Depot laboratory at Deptford.

The total number of samples examined during the year was 491,039, an increase of 21,397 over that of the preceding year. In addition to this purely routine analysis—if such a term can be properly applied to so heterogeneous a collection of samples, involving the most varied and detailed methods of examination—a considerable amount of work has been done in connexion with the revision of existing methods and the investigation of new methods of detection and determination of substances; moreover, the Government Chemist (Sir Robert Robertson), his deputy, and staff serve on various official committees, and from time to time are called upon to give evidence in legal proceedings.

The report shows, for example, that exceptional care is necessary in the sampling of milk supplied in bottles, the absence of air space rendering mixing difficult; that forty samples of fresh milk in churns imported from the Continent were satisfactory; and

that although only 45 per cent of the samples of imported cheese examined had been prepared from whole milk, in the absence of regulations relating to the marking of skimmed milk cheese no action could be taken in respect of the remainder. On the other hand, out of 69 samples of condensed milk or milk powder, seventeen had been prepared from skimmed milk without being so declared on the package, as required by law.

More than fifty samples of river water, muds, and effluents were examined from the point of view of fish life and the effect of pollution on fish and fish food. Incidentally, North Sea herring and sea water were found to contain traces of arsenic. A sheep's jawbone containing teeth with a metallic lustre, popularly believed to be a deposit of gold, was examined; the metallic sheen appeared to be due to the effect of light on a laminated crystalline structure mainly composed of calcium phosphate. In 50 per cent of the samples of non-alcoholic beer the amount of proof-spirit present exceeded the legal limit of 2 per cent, and 14 out of 36 samples of herb beer, ginger beer, etc., contained alcohol ranging from 2 to 5 per cent of proof spirit.

The silk and artificial silk duties have in many cases necessitated much detailed examination of goods. Saccharin is searched for in all likely preparations, and is indeed found in a large proportion of imported substances, usually containing some other dutiable ingredient. Large stocks of tea in bonded warehouses on the banks of the Thames had to be re-examined on account of damage caused by floods. It is also worth recording that more than 200 milligrams of radium were recovered during the year from accumulated stocks of disused luminous compass dials etc., and the product was concentrated into a high-grade salt.

The Embrittlement of Boiler Plates.

IN the issue of NATURE for May 7, 1927, p. 686, an account was given of work which had been carried out at the Experimental Research Station of the University of Illinois over a period of several years. The authors, S. W. Parr and F. G. Straub, showed that the embrittlement of boiler plates takes place as a result of the simultaneous action of a tensile stress exceeding the elastic limit, and of a concentrated solution of caustic soda. The amount of the latter required exceeds, however, anything which could normally be present in the boiler water itself, but this concentration can occur in the seams where the plates have been riveted together, and it is in this locality that embrittlement cracking takes place.

Bulletin No. 177 by the same authors confirms the earlier work, both by laboratory tests and in actual boiler practice, but carries the question of the inhibition of the embrittlement a good deal further. It was shown in the earlier paper that, provided the amount of sodium sulphate in solution in the water was sufficient, embrittlement could be prevented. The American Society of Mechanical Engineers has recommended, therefore, that the water in boilers should be maintained with a ratio of sodium sulphate to total alkalinity, calculated as sodium carbonate, of not less than the following: For a working pressure in the boiler up to 150 lb. per square inch, 1 to 1; from 150 lb. to 200 lb. per square inch working pressure, 2 to 1; and above 250 lb. per square inch, 3 to 1. It is doubtful whether any case of brittleness has ever been observed in boilers where these conditions have been fulfilled.

The authors in their later paper have pointed out in a very clear manner the danger which may ensue as the result of the addition of water-softening materials, such as soda ash or zeolite, in the absence of adequate supervision, and give numerous examples of failures in boilers which have resulted from the use of those materials without proper control. From the very large number of cases of boiler embrittlement which have come under their examination, the authors state that 10 per cent only were the result of embrittlement by natural water, 20 per cent occurred with water treated with soda ash, and no less than 70 per cent with water treated with zeolite. The presence of sodium chloride in the boiler water is also shown to accelerate the attack very greatly.

Attempts to prevent the formation of caustic soda in the boilers by the addition of organic matter have been made, but with no success in the authors' hands, since it is impossible appreciably to retard the decomposition of the sodium carbonate by this means. Apparently the most successful method of preventing brittleness is by the addition of soluble phosphates: a solution of sodium phosphate containing 0·6 gram of the PO_4 radical per litre has been shown to prevent cracking even where a steam pressure as high as 500 lb. per square inch has been used, and where the mild steel has been subjected to a tensile stress of 45,000 lb. per square inch, together with a concentration of sodium hydroxide of roughly 300 grams per litre. In a check experiment, using the same conditions apart from the addition of the phosphate, fracture occurred in the steel in twenty-four hours. It is stated that a United States patent has been taken out to cover this use of sodium phosphate. Other substances, such as chromates, tannates, acetates, etc., may also possess value in this connexion.

The authors have been unable to find any steel otherwise suitable for boiler plates, which is resistant to the embrittlement resulting from the simultaneous action of stress and caustic soda attack.

The Public Health.

THE ninth Annual Report of the Ministry of Health, 1927–28,[1] is a mine of information on various aspects of the public health. It is divided into five sections, one of which comprises the report of the Welsh Board of Health, and a series of appendices. The five main divisions deal with the public health, local government and finance, administration of the poor law, and National Health Insurance and Contributory Pensions. Among the general subjects in the section on public health, reference is made to the coming into force of the Therapeutic Substances Act, 1925, and the passage of a Bill through Parliament to amend the Mental Deficiency Act, 1913, to allow of the treatment of young persons suffering from the after effects of encephalitis lethargica; mental defectiveness is now defined as a condition incomplete development of mind existing before th age of eighteen years, whether inherent or caused b disease or injury. Work has also been commenced investigate the causes of maternal mortality and pue peral fever: the maternal mortality rate has bee almost stationary in Great Britain for the last twen years, indicating that special efforts must be made reduce it.

In the section on the inspection and supervision food, it is noted that the demand for milk of h hygienic quality continues to increase. Although addition of preservatives to articles of food is r restricted, a few samples out of the large num taken, chiefly sausages and other meat products,

[1] "Ninth Annual Report of the Ministry of Health, 1927–28." Pp. 292+xviii. (London: H.M. Stationery Office, 1928.)

found to contain excess of, or forbidden, preservatives. Some canned vegetables were found to contain a copper colouring matter. Of 124,264 samples of food taken for analysis, 5·5 per cent were found to be adulterated, or not up to standard: no milk samples contained preservatives, but six contained colouring matter, and forty-four dirt: the chief defect in these samples was failure to reach the required standards. A few samples of butter were found to consist wholly or partly of margarine: some contained excessive amounts of preservatives and others of water: no sample of margarine was found to contain any mineral oil. Some samples of lard contained vegetable fat, and some of suet an excessive amount of rice flour or tarch. Among other adulterants found in different rticles of food were arsenic in flour, glass in lemon rystals, lead in aerated waters, phosphoric acid as he chief constituent of a "pure raspberry cordial," nd boric acid in continental sweets: some samples f egg powder consisted merely of coloured baking owder, and a coloured and flavoured solution of ugar in water found a sale as "black currant wine." hose results show the necessity of keeping a watchful ye on the purity of the nation's food supply.

Among the infectious diseases, mild smallpox emained prevalent, but the fatality rate for diphtheria nd scarlet fever showed a considerable decline: the umber of cases of encephalitis lethargica also ecreased, but the fatality rate was higher.

In the section on public health will be found re-orted also the progress of maternity and child welfare chemes, housing and town planning. The section on he administration of the Poor Law gives an interesting ccount of a subject which is of great importance to he country at the present time: it is of interest to ote that there is a large increase in the numbers of hose seeking out-relief at the time of a general holiday. he working of the National Health Insurance and he Pensions scheme is fully described in the last ection of the report, which is altogether a valuable ompendium of the many-sided aspects of the public ealth.

University and Educational Intelligence.

Bristol.—The first Henry Herbert Wills Memorial ecture, founded to commemorate the gift of the hysical Laboratory to the University, will be de-ivered by Sir James Jeans on Oct. 30 at 5.30 P.M. he title of his lecture will be "The Physics of the niverse."

King's College, University of London, is this ear celebrating the centenary of its foundation, and n appeal is being issued for £350,000 to enlarge he College and to provide a much-needed endow-ent. Of this sum about £100,000 is needed to dow special chairs and studentships in physics, hysical chemistry, electrical engineering, and physio-ogy. Before the War, the full-time day students in ttendance at the College numbered about 700. Now here are more than 1200 undergraduate students, ore than 300 postgraduate students, and about 500 ening students. Another new and important de-lopment since 1913 has been the annual scheme of e public lectures by means of which the latest scoveries in science and learning have been made cessible to large popular audiences. This increase numbers and the modern requirements of teaching d research are making new demands which must met. Among the most pressing needs are the truction of a new Anatomy Building in proximity the physiological laboratories and the reconstruc-and extension of the chemical laboratories, which will cost £125,000. Donations should be sent to one of the treasurers, the Right Hon. Reginald McKenna, or Sir Edward Troup, at King's College, Strand, W.C.2, or to the College Bankers, Messrs. Coutts and Co., at 440 Strand, W.C.2, for the credit of King's College Centenary Appeal Account.

The 'land-grant' colleges and universities of the United States had in 1926 nearly three times as many students (not including pre-matriculation, summer school, extension, or correspondence students) as the universities and university colleges of Great Britain, and more than one-fifth of the total college and university enrolment of the United States. Full statistics regarding them are to be found in *Bulletin No. 37* of 1927 of the United States Bureau of Education. The Land-Grant Act of 1862, known as the first Morrill Act, allotted to the States of the Union more than ten million acres of public lands for the establishment in each State of a college in which the leading object was to be "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." Thus with admirable foresight was machinery created for ensuring that the United States should be well equipped after the Civil War for the coming international rivalry in industry. During the present century, and especially during the years from 1915 until 1926, the progress of these institutions has been astonishingly rapid. Their student enrolment increased during those ten years by 150 per cent, whilst their total annual receipts increased from 36 to 124 million dollars. On experimental stations (chiefly agricultural) and other organised research work, the annual expenditure exceeds ten million dollars. It is largely through the work of their agricultural experiment stations, first established in 1887, that the land-grant colleges are contributing towards the general adoption in American agriculture of scientific organisation in place of the haphazard and traditional methods of the past.

In "Rural Education in England and the Panjab" (*Occasional Report* No. 15 of the Bureau of Education, India) two members of the Indian Educational Service describe impressions received in the course of a three-months' tour throughout the length and breadth of England, and make instructive comparisons with conditions in the Panjab, and suggestions for creating a genuinely 'rural atmosphere' in village schools in that province. The 'rural bias' question which has been so much in evidence of late in conferences on education in England, is a hundred-fold more important in India, owing to the immense preponderance of agricultural as compared with urban occupations, the much deeper cleavage between village and urban life, and the hitherto almost exclusively urban bias of the teacher-training institutions and inspectorate. Attempts, begun more than forty years ago, to popularise and vitalise the town-made teaching in the country districts of the Panjab, proved ineffectual until, soon after the War, school farms were introduced. Of the reforms recommended in the present report, the most important have to do with the training of village teachers. In selection of candidates, more consideration should be given to health, physique, caste, and domicile, and the duration of the course should be increased from 9 months to 18 or 24 months. Appended to the report are a useful comparison of rural science teaching in primary schools in Ireland with similar teaching in the Panjab, and an account of a new School of Rural Economy at Gurgaon, where students are trained, not for teaching in schools, but for moving from village to village, showing (by practice as well as precept) how the people may improve their conditions of life.

Calendar of Customs and Festivals.

October 28.

St. Simon and St. Jude's Day.—A day which in popular tradition was specially associated with a downfall of rain. It was said that in 1536 a battle between the king's troops and the rebels in Yorkshire was prevented by the heavy fall of rain which took place on the eve of this day.

On this day the paring of a whole apple thrown over the shoulder by the right hand, while the inquirer stands in the middle of the room and repeats the appointed verses, will form the first letter of the surname of the future husband, but if it breaks, the inquirer will never marry. The apparently meaningless addition that the pips of the apple should be put in spring water and drunk, for which no reason is given, betrays the charm.

October 29.

St. Modwen's Day.—Observed as a fair for the sale of cheese at Burton-on-Trent.

October 30.

From this day until Nov. 7 at Chetwode, the Lord of the Manor had the right to levy 'Rhyme Toll' on all cattle found within the hundred. The period was proclaimed by the blowing of a whelk shell at certain prescribed points. The tradition is that the toll is a grant to the Lord of Chetwode for having rid the district of a savage boar.

October 31.

Hallow's Eve, the vigil of All Saints' Day, is marked by a number of the observances usually occurring in a period of transition from one season to another in the popular calendar, and thereby pointing to a pagan origin. These customs are for the most part connected with divination in various forms—at All Hallows in more variety than at any other time of the year—and the cult of spirits.

Sometimes the festival appears to have served as a final celebration of the harvest. Both nuts and apples, which in primitive Britain were the staple, and indeed almost the only, fruits, appear in the customary rites. Hallow Eve is known as 'Nut-crack Night,' and bobbing with the mouth only for apples in a bowl of water or suspended on a string is a widespread custom. At St. Ives it was obligatory that every child should receive an apple on 'Allan Day.'

Divination was practised by sticking apple pips on the cheeks, by putting nuts in the fire, by pulling oat-straws from the stack, by sowing hemp seed, and in many other ways. In Scotland cabbages were drawn from the ground by girls blindfold, the ground around the roots being the basis of interpretation; while simulation of the action of winnowing the corn with a winnowing fan in a barn, after lifting the doors from the posts, it was believed, would cause an apparition to appear and pass through the barn.

In the Celtic calendar Samhain (Nov. 1) marked the opening of the winter, the period among a pastoral people when the cattle are brought in from the hills to the fold. At this time it was customary, not only in Britain but also throughout the whole of Europe, for bonfires to be lighted. This practice survived in the custom of the master of the house carrying a bunch of lighted straw around the fields. This drove away the witches and averted their evil influence. In Scotland a fire stick was waved about with the same object; while in Lancashire, where the famous Lancashire witches gathered in the Forest of Pendle on this night for their terrible rites, the custom was observed of 'leeting' or 'lating' the witch by carrying about a candle on the hills from eleven to twelve o'clock. In Ireland a lighted candle was placed in every window. These customs are to be regarded as survivals of the Samhain fire; but there are many other cases which are more obvious. In the Isle of Man *Sanin* was observed by kindling a fire with ceremony to avert the evil influence of witches and fairies.

In many localities where the lighting of bonfires is recorded, their character is often emphasised by the fact that the bystanders danced round them or leaped through them—a familiar pagan rite still practised among primitive peoples. Pebbles also were cast into the fires, whether they were found intact or had split into fragments which could not be identified the next morning, determining the fate of the person after whom the pebble had been named.

The 'witches' against whom the fire in peasant custom is directed in a more primitive stage of belief are the spirits, and especially the spirits of the dead. This is shown by the Church's cult of All Souls' on Nov. 2, by the custom of baking a 'soul cake,' and by the practice of children going 'a souling,' that is, of going from house to house begging 'soul cakes.' In Ireland it is recorded, though perhaps not on very good authority, that parties went from house to house reciting verses which called upon the inhabitants to bring forth the 'black sheep,' an allusion to a sacrifice to the dead on the following day of Samhain, for which a *black* sheep would be the appropriate victim.

In Morocco the period beginning about the month of October is regarded as blessed. Butter churned, wheat sown, and lambs born at this time have special virtue, and are reserved for the entertainment of special guests, a small quantity only being sufficient to satisfy them. There is a saying that if October milk, butter, wheat, and lamb come together in the same dish in October, the dish will break.

November 1.

All Hallows. All Saints' Day.—A festival originally celebrated on May 1, and afterwards moved to Nov. 1, a fact which in itself would be sufficient to make it clear that the Church had taken over an earlier pagan celebration while continuing the custom of lighting fires on the hill-tops. The reason for the transference may have been that not only was the eve of Nov. 1 the great pagan festival of the cult of the dead, but also in all probability it, rather than Beltane on May 1, was the beginning of the Celtic year. In the Isle of Man they sang a song greeting the day as the New Year. In Ireland all fires were extinguished at Samhain and a sacred fire kindled from which all the fires in the kingdom had to be relighted. It is also significant that there is a more frequent and varied practice of divination at this than at any other festival of the year.

There is a suggestion of a Samhain sacrifice in the custom recorded in the parish of Lymm where a horse's skull was gaily decorated with ribbons, fastened on a short pole and carried by a man covered with a horse cloth. Sometimes the horse was led by a chain through its lip held by another in the procession by which the 'horse' was escorted from house to house. At Chester a similar 'horse,' known as 'Old Hob,' was led about the town from All Souls until Christmas.

November 2.

All Souls' Day.—Dedicated by the Roman Church to services for the repose of the dead. In popular observance it is marked by the making of soul cakes, blessing beans, and other customs, including the nut and apple omens and the lighting of fires which carry on the practices of All Hallows.

Societies and Academies.

London.

Optical Society, Oct. 11.—Col. J. W. Gifford: Lenses and equipment for ultra-violet photography. A description is given of the type of photographic doublet generally known as rapid rectilinear, in which (1) fluorite and quartz, (2) quartz and calcite, are substituted for the ordinary crown and flint glasses. These doublets are therefore more or less transparent to the ultra-violet as well as to the visual spectrum. Corresponding lists of focal lengths for twenty-one wave-lengths are given, as well as the radii, thicknesses, etc., for construction. A cement transparent to the ultra-violet for use with these lenses is described, and photographs of the spectra transmitted by certain light filters are given.—H. Boegehold: Some remarks on old English objectives. Constructional data, refractive indices, and ν values for the objective of an old Ramsden telescope are given with historical notes.—Thomas H. Court and Moritz von Rohr: On the development of spectacles in London from the end of the seventeenth century (first paper on the Court llection). English spectacles before 1666 are very perfectly known. After the Great Fire, horn spectacles with rigid and with split frames were advertised, d leather-framed and hinged spectacles appeared. is period witnessed Marshall's improvement in nding and polishing a number of surfaces at the me time. In the eighteenth century the London tisans became the leading spectacle opticians, as they veloped the temple spectacles and very efficient nose ectacles in horn and steel, and leather and steel. 'alker's untenable objections to Wollaston's periopic spectacles are treated. The nineteenth century as not favourable to the master craftsman in London, large spectacle factories altered the position of the ectacle vendors.

Diary of Societies.

FRIDAY, October 26.

ciation of Economic Biologists (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 2.30.—R. N. Chrystal: the Biology of *Sirex cyaneus* and its Parasites.—K. St. G. Cartwright: Notes on a Fungus associated with *Sirex cyaneus*.

al Society of Medicine (Disease in Children Section), at 5.—Prof. Gallens: Dyspepsia in Children.

sical Society (at Imperial College of Science), at 5.—Dr. A. Ferguson and J. P. Andrews: An Experimental Study of the Anti-elastic Bending of Rectangular Bars of Different Cross-Sections.—B. S. Smith and F. D. Smith: An Instrument for the Production of Known Small High-Frequency Alternating Electromotive Forces.—Demonstration by H. F. T. Jarvis of a New Device for Thermostatic Control.

al College of Surgeons of England, at 5.—Sir Arthur Keith: The Development of the Human Foot and its Bearing on Club-foot—Illustrated by specimens.

stitution of Electrical Engineers (London Students' Section), at 6.15.—Prof. S. Parker Smith: Ignition Systems in Automobiles.

stitution of Chemical Engineers (at Institution of Civil Engineers), at 6.30.—Prof. A. L. Mellanby: Fluid Jets and their Practical Applications.

stitution of Locomotive Engineers (at Hotel Metropole, Leeds), at 7.—E. de H. Rowntree: Glimpses of Colonial Railway Conditions.

nchester Literary and Philosophical Society (Chemical Section), at 7.

stitution of Mechanical Engineers (Informal Meeting), at 7.—R. C. Macdonald: Mechanical Plant in Gas Works.

stitution of Electrical Engineers (North-Eastern Students' Section) (at Armstrong College, Newcastle-on-Tyne), at 7.15.—L. B. Harmer: Post Office Telephones and the Public.

nchester Association of Engineers (at Engineers' Club, Manchester), 7.15.—J. S. G. Primrose: The Microscope as applied to Engineering.

or Institution of Engineers, at 7.30.—G. W. Tookey: Legal Protection for Originality and Invention.

al Society of Medicine (Epidemiology Section), at 8.—Dr. F. E. Fremantle: The Authority of Parliament in Relation to Epidemic Disease (Presidential Address).

SATURDAY, October 27.

stitution of Municipal and County Engineers (Yorkshire District) (at Town Hall, Pontefract), at 1.45.—W. H. Newton: Notes on the Ancient Borough of Pontefract, and Some of its Recent Municipal Works.

North of England Institute of Mining and Mechanical Engineers (Associates' and Students' Section) (Newcastle-upon-Tyne), at 2.30.—W. S. Armstrong: Bore-holes and their Purposes.—F. E. Smyth: Diamond Boring Applied to Tapping Drowned Areas Underground.—*Paper open for further discussion*:—The Use of Carbon-Monoxide Gas-Masks in Mines, R. White.

Institute of British Foundrymen (Lancashire Branch) (at College of Technology, Manchester), at 7.—T. Makemson: The Prospects and Opportunities of Young Foundrymen (Presidential Address).

South-Eastern Union of Scientific Societies (Autumn Meeting).—Visits to Croydon Aerodrome and Air-Port, and to Whitgift's Hospital, Croydon.

MONDAY, October 29.

Cambridge Philosophical Society (Annual General Meeting) (in Cavendish Laboratory), at 4.30.—Sir Ernest Rutherford: The Energy of Atomic Nuclei.—Dr. P. A. M. Dirac: The Basis of Statistical Quantum Mechanics.—P. M. S. Blackett: On the Design of a Camera for a Wilson Apparatus.—L. H. Gray: Theoretical Considerations Concerning Penetrating Radiation.—N. A. de Bruyne: Note on the Effect of Temperature on the Auto-electronic Discharge.—J. Hargreaves: The Dispersion Electrons of Lithium.—E. E. Watson: Current Measurement with a Compton Quadrant Electrometer.—*Papers to be communicated by title only*:—Dr. D. R. Hartree: The Propagation of Electromagnetic Waves in a Stratified Medium.—Dr. D. C. Rose: Some Experiments on the Multiple Scattering of Alpha Particles.—D. Burnett: Directional Properties of Wireless Receiving Aerials.—L. A. Pars: The Classification of Orbits.—J. R. Wilton: A Note on Ramanujan's Arithmetical Function $\tau(n)$.—Miss W. L. C. Sargent: On Young's Criteria for the Convergence of Fourier Series and their Conjugates.

Royal College of Surgeons of England, at 5.—T. W. P. Lawrence: Demonstrations of Surgical Specimens.

Institution of Electrical Engineers (Informal Meeting), at 7.—The President and others: Discussion on Our Profession from a Manufacturer's Point of View.

Illuminating Engineering Society (Manchester Section) (at Electric Lighting Service Bureau, Manchester), at 7.—J. L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry.

Society of Chemical Industry (Yorkshire Section) (at Great Northern Station Hotel), at 7.15.—W. Bain: Asbestos and its Industrial Application.

Bradford Engineering Society (at Technical College, Bradford), at 7.30.—A. H. Gledhill: Time Recording and Costing.

TUESDAY, October 30.

Institute of Actuaries, at 5.—A. Levine: Presidential Address.

Royal Institution of Great Britain, at 5.15.—Prof. H. L. Callendar: Conggregation *versus* Continuity in the Change of State from Liquid to Vapour (Tyndall Lectures) (I.).

Institution of Electrical Engineers (North-Western Centre) (at Midland Hotel, Manchester), at 7.—J. H. Williams: Chairman's Address.

Institution of Electrical Engineers (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—F. S. G. Hinings: Chairman's Address.

Royal Photographic Society of Great Britain, at 7.—Demonstration by Colour Photographs, Ltd., of a New Colour Process.

Electrical Association for Women (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street, W.C.).—Miss Gladys Burlton: The Study of Personal Salesmanship—Demonstrating Electrical Apparatus.

WEDNESDAY, October 31.

Institution of Municipal and County Engineers (at Town Hall, Accrington), at 11.30.—Informal discussion on Bricks and Brickmaking.

Illuminating Engineering Society (Newcastle Centre) (at North-East Coast Lighting Service Bureau, Newcastle-upon-Tyne), at 7.15.—J. L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry.

Society of Chemical Industry (Newcastle-upon-Tyne Section) (in Chemical Lecture Theatre, Armstrong College), at 7.30.—Prof. H. V. A. Briscoe: Recent Investigations of the Properties of Coke.

Faraday Society (jointly with Electroplaters' and Depositors' Technical Society) (at Northampton Polytechnic Institute), at 8.15.—Discussion on:—The Causes and Prevention of Pitting in Electro-deposited Nickel, D. J. Macnaughtan and A. W. Hothersall; On the Effect of Colloids in the Electro-Deposition of Silver from Silver Nitrate Solutions, S. Wernick; The Hardness of Electro-deposited Nickel, D. J. Macnaughtan and A. W. Hothersall; Investigations on the Electro-Deposition of Silver, E. B. Sanigar.

THURSDAY, November 1.

Royal Society, at 4.30.—Prof. O. W. Richardson and F. C. Chalklin: The Soft X-Ray Levels of Iron, Cobalt, Nickel, and Copper.—Dr. A. Müller: A Further X-Ray Investigation of Long-Chain Compounds.—Dr. J. E. Lennard-Jones and B. M. Dent: The Change in the Lattice Spacing at a Crystal Boundary.—R. W. James and G. W. Brindley: A Quantitative Study of the Reflection of X-Rays by Sylvine.—*Papers to be read in title only*:—G. S. Mahajani: A Contribution to the Theory of Ferromagnetic Crystals.—E. B. Moullin: An Ampere Meter for Measuring Currents of very High Frequency.—S. Goldstein: The Influence of the Earth's Magnetic Field on Electric Transmission in the Upper Atmosphere.—Prof. S. R. Milner: The 'Action' of an Electromagnetic Field.—Prof. H. A. Wilson: Chemical Equilibrium in the Vapour of a Mixture of Paraffins and Unsaturated Hydrocarbons.—E. H. Gowan: The Effect of Ozone on the Temperature of the Upper Atmosphere.—G. I. Finch and J. C. Stimson: The Electrical Condition of Hot Surfaces during the Adsorption of Gases. Part II.—N. A. de Bruyne: The Action of Strong Electric Fields on the Current from a Thermionic Cathode.—H. Gregory and C. T. Archer: The Thermal Conductivities of Carbon Monoxide and Nitrous Oxide.—N. K. Adam and G. Jessop: The Structure of Thin Films. Part XII.—Prof. H. Levy and A. G. Forsdyke: The Steady Motion and Stability of a Helical Vortex.—R. J. Cornish: Flow in a Pipe of Rect-

angular Cross-Section.—Prof. J. C. McLennan and G. Greenwood: The Decomposition of Ammonia by High Speed Electrons.—Prof. J. C. McLennan and A. M. I. A. W. Durnford: The Zeeman Effect for the Spectrum of Tantalum.—Prof. J. C. McLennan, R. Ruedy, and E. Cohen: The Magnetic Susceptibility of Single Crystals of Zinc and Cadmium.—Prof. J. C. McLennan, R. Ruedy, and A. C. Burton: An Investigation of the Absorption Spectra of Water and Ice with reference to the Spectra of the Major Planets.—Prof. J. C. McLennan, H. J. C. Ireton, and E. W. Samson: On the Luminescence in Solid Nitrogen under Cathode Ray Bombardment.—Dr. A. T. Doodson: The Analysis and Prediction of Tidal Currents from Observations of Times of Slack Water.—Prof. C. V. Boys: Solid Dipleidoscope Prisms, Supplement.—Prof. J. S. Townsend: Motions of Electrons in Gases.—Dr. J. E. Lennard-Jones and H. J. Woods: The Distribution of Electrons in a Metal.—W. West, R. H. Muller, and E. Jette: Studies on Fluorescence and Photosensitisation. I. Introduction.—E. Jette and W. West: Studies on Fluorescence and Photosensitisation. II. Fluorescence in Aqueous Solution.—R. H. Muller: Studies on Fluorescence and Photosensitisation. III. Photosensitisation and Fluorescence.—Prof. W. A. Bone, L. Horton, and L. J. Tei: Researches on the Chemistry of Coal. V.—P. White and G. Millington: The Velocity Distribution of β-Particles after passing through Thin Foils.—Prof. C. G. Darwin: (a) On the Magnetic Moment of the Electron; (b) On the Diffraction of the Magnetic Electron.—P. C. Allen and C. N. Hinshelwood: The Catalytic Decomposition of Gaseous Acetaldehyde at the Surface of Various Metals.—R. Chaplin: The Sorption of Carbon Tetrachloride at Low Pressures by Activated Charcoals.—N. A. Alston and J. West: The Structure of Topaz.—H. J. Braddick and H. M. Cave: The Rate of Emission of Alpha Particles from Radium.—Prof. W. E. Curtis and A. Harvey: The Structure of the Band Spectrum of Helium. V.—Prof. W. A. Bone, D. T. A. Townend, and G. A. Scott: Gaseous Combustion at High Pressures. Part XI.—Prof. W. A. Bone, D. M. Newitt, and C. M. Smith: Gaseous Combustion at High Pressures. Part XII.—K. Krishnamurti: Investigations on the Scattering of Light in Colloidal Solutions and Gels. I. Agar Sol and Gel.—Dr. P. E. Shaw: Tribo-Electricity and Friction. IV. Electricity due to Air-blown Particles.—Prof. C. V. Raman and K. S. Krishnan: The Production of New Radiations by Light Scattering. Part I.—Prof. H. L. Callendar: Steam Tables and Equations extended by Direct Experiment to 4000 lb./sq. in. and 400° C.—W. R. C. Coode-Adams: The Refractive Index of Quartz.—R. C. Johnson: The Band Spectra of the Alkaline Earth Halides. I. CaF, SrF. II. BaF, MgF.—J. M. Walter and S. Barratt: The Band Spectra associated with Zinc, Cadmium, and Mercury.—Dr. W. Jevons: Observations in connexion with the Band Systems of the Fluorides of Beryllium and Magnesium.—G. Temple: The Scattering Power of a Bare Nucleus according to Wave Mechanics.—J. Topping: On the Form and Potential Energy of the Isomorphous Crystals, Ruby (Al_2O_3) and (Fe_2O_3).

LINNEAN SOCIETY OF LONDON, at 5.—V. S. Summerhayes: A Revision of the Australian Species of *Frankenia*.—Dr. Helene E. Bargmann: The Morphology of the Central Nervous System in the Gastropoda Pulmonata.—Miss T. L. Prankerd: Studies in the Geotropism of Pteridophyta. 4. On Specificity in Graviperception.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. G. Gibson: Pyelitis and Pyelonephritis (Bradshaw Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Capt. G. Pitt-Rivers: The Clash of Culture (1.). Race and Culture.

BIOCHEMICAL SOCIETY—UNIVERSITY OF BIRMINGHAM (at University of Birmingham), at 5.30.—F. E. Salt and H. B. Salt: Essential Oils and Perfumes.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (jointly with Electrical Association for Women) (at Municipal College, Birmingham), at 7.—Dr. S. Z. de Ferranti: Electricity in the Service of Man (Faraday Lecture).

ILLUMINATING ENGINEERING SOCIETY (Glasgow Centre) (at 25 Bath Street, Glasgow), at 7.30.—J. L. H. Cooper: An Investigation of Electric Lighting in the Engineering Industry.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Engineering Group) (in Chemical Department, Bristol University), at 7.30.—W. F. Darke and E. Lewis: Glycerin and its Substitutes in Industry.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 7.45.—W. D. Douglas and Miss C. B. Pettifor: The Testing of Adhesives for Timber.

CHEMICAL SOCIETY, at 8.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (at Glasgow).—Eng.-Comdr. J. B. Sidgwick and Dr. V. E. Pullin: Steel Castings.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch) (at Manchester).—A. B. Mallinson: An Up-to-date Cotton Mill Power Plant.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch: Graduates' Meeting) (at Leeds).—B. H. Thorp: Gaseous Explosions.

FRIDAY, NOVEMBER 2.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.—A. H. Mundey: Die Casting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Evolution of the Human Foot and its Bearing on Orthopædic Disorders of the Foot.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—E. D. P. Evans: Wye Rivers.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College), at 5.30.—Miss E. M. Bartlett: Some Types of Æsthetic Judgment.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—E. G. Barrilon: From Theoretical Hydrodynamics to Practical Ship Design.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.—Miss Agnes B. Warburg: Light and Space.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Cinematograph Film showing the Principle, Construction, Erection, and Operation of the Babcock Boiler.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Annual Conversazione.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Sections of Institute of Chemistry, Society of Dyers and Colourists, and Manchester Literary and Philosophical Society).—Sir John E. Russell: Application of Chemistry in Modern Farming.

SATURDAY, NOVEMBER 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. T. E. R. Phillips: Recent Observations and Discoveries respecting the Planets (I.).

PUBLIC LECTURES.

SATURDAY, OCTOBER 27.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. Edith Durham: A Montenegrin Ballad of Old Tribal Life.

TUESDAY, OCTOBER 30.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. A. T. Henderson: Studies in Asthma and Related Diseases. Clinical Studies—(a) Hay Fever, Seasonal and Perennial; (b) Skin Manifestations: Urticaria, Eczema, Angioneurotic Œdema, Ulceration of the Cornea; (c) Summary and Conclusions (Harben Lectures).

UNIVERSITY OF BRISTOL, at 5.30.—Sir J. H. Jeans: The Physics of the Universe (Henry Herbert Wills Memorial Lecture).

KING'S COLLEGE, at 5.30.—Sir Francis Younghusband: Philosophy, Science, and Religion.

GRESHAM COLLEGE (Basinghall Street), at 6.—W. H. Wagstaff: Geometry. (Further Lectures on Oct. 31, Nov. 1 and 2.)

UNIVERSITY OF BRISTOL (in Physiological Lecture Theatre), at 8.30.—Dr. J. O. Symes: The Relation of Erythema Nodosum to Tuberculosis and other Diseases (Long Fox Memorial Lecture).

WEDNESDAY, OCTOBER 31.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. S. W. Fisher: Pains and Pleasures of a Miner's Life.

KING'S COLLEGE, at 5.30.—Prof. E. Wilson: Electrical Science and Industry.

THURSDAY, NOVEMBER 1.

ROYAL SOCIETY OF MEDICINE, at 5.—Prof. M. Hajek: Laryngo-Rhinology and General Medicine (Semon Lecture).

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Miss U. M. Ellis-Fermor: The Poetry of Travel (Elizabethan Age).

FRIDAY, NOVEMBER 2.

UNIVERSITY COLLEGE, at 5.30.—Dr. J. S. Owens: Smoke Pollution of the Air and Public Health. (Further Lectures on Nov. 9 and 14.)

SATURDAY, NOVEMBER 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. W. Edwards: A Naturalist's Trip to the Southern Andes.

CONGRESSES.

OCTOBER 29, 30, 31, NOVEMBER 1.

INTERNATIONAL CONFERENCE ON LIGHT AND HEAT IN MEDICINE, SURGERY, AND PUBLIC HEALTH (at University of London, S.W.7).

Monday, Oct. 29.

3.30–5.—Dr. W. J. O'Donovan: Actinotherapy in Nervous Affections of the Skin.

Dr. F. Nagelschmidt: A New Method of Applying Heat by Diathermy.

7.30–9.—Dr. W. Flaskamp: Light and Heat in Gynæcology.

Dr. W. K. Russell: A Consideration of Apparatus for the Production of Ultra-violet Rays for Medical Purposes.

Tuesday, Oct. 30.

3.30–5.—Dr. C. B. Heald: The Development of New Electro-therapeutic Apparatus.

Dr. F. Nagelschmidt: Foam Treatment.

7.30–9.—Dr. M. J. Dorcas: Energy Distribution of Various Types of Arc Lamps.

Wednesday, Oct. 31.

3.30–5.—F. Talbot: Actinotherapy and Dental Caries.

Dr. A. J. Cemach: U-V Therapy in Oto-rhino-laryngology.

7.30–9.—Sir Henry Gauvain: Heliotherapy and Artificial Light Treatment in Surgical Tuberculosis (Film).

M. Weinbren: Ultra-violet Radiation in the Treatment of Chronic Pulmonary Tuberculosis.

Thursday, Nov. 1.

3.30–5.30.—Dr. A. Eidinow: Photosensitisation.

Dr. C. C. Morrell: Plant Pigments in Relation to Photosensitisation.

T. C. Angus: The Efficiency of Ultra-violet Light Producers.

NOVEMBER 3.

SOCIOLOGICAL SOCIETY, LEPLAY HOUSE, AND TOURS ASSOCIATION (at London Day Training College).

At 10.30 A.M.—Reports on the Work done during the past Year by Leplay House Sociological Society and Leplay House Tours Association.

At 11.15 A.M.—Social Studies in Majorca.—Miss M. Mapleaden: Geology and Flora in Majorca.—G. Morris: Some Notes on Swedish Lapland.

At 2.30.—C. C. Fagg: Some Results of the Croydon Survey.

At 4.45.—A. Farquharson, and Group Leaders from the Tours Students' "Camp," 1928: Field Studies at St. Peter.

SATURDAY, NOVEMBER 3, 1928.

CONTENTS.

The Understanding of Relativity.

NINE years have passed since the historic meeting at the Royal Society, Burlington House, on Nov. 6, 1919, when the British eclipse expedition announced the confirmation of Einstein's prediction, from the general theory of relativity, that starlight would be deflected by the gravitational field of the sun. Rarely has a scientific discovery, apparently so forbidding in character, been attended by such an outburst of interest and inquiry. The silent, matter-of-fact way in which relativity has been absorbed into the general scheme of physics stands in striking contrast to the fanfare with which it has been received by the general public. From the time of the Burlington House meeting onwards there has been a ceaseless procession of books, pamphlets, newspaper articles, lectures, pictures, even cinema films, dedicated to the task of making plain to the man in the street what relativity really means.

Even the most easily satisfied expositor can scarcely claim that a reasonably proportionate amount of success has been achieved. Few phenomena are more rarely encountered than a non-scientific man who understands relativity, or even one who claims to do so. It has become almost a commonplace that the theory is unintelligible to the ordinary person. One who affects to understand it is apt to be regarded with suspicion. The rumour has gone forth, and is widely accepted, that there are only three (or is it eleven ?) people in the world who know what it is all about. Judged solely by their results, the attempts to express relativity in ordinary language represent the most conspicuous failure of modern scientific exposition.

It is easy to find defects in many of the attempts. Some have been made by writers who themselves have a very hazy notion of the matter. Others are unintelligible and terribly dull. Others, again, are too much concerned with details, and present a skeleton rather than a spirit ; and so on. But all these things do not explain the situation. They are defects common to a certain proportion of all popular scientific works. Books on 'radio,' for example, can claim their share of them, yet the country is full of experts in this subject who have little physics and less mathematics. The cause of the failure to make relativity intelligible must be sought elsewhere. As a possible contributor to the failure, and a spectator of the efforts of many others, we may be permitted to record a few reflections for the consideration of future interpreters.

Undoubtedly the greatest difficulty in the ma ver
is the universal idea that relativity is hard to un er-
stand. A prejudice of this kind is generally f tal
to the acquirement of any knowledge, but it is ar-
ticularly so in the case of relativity, first becau it
is accepted with such implicit trust, and seco lly
because it is not true. The real difficulty that e-
sets the beginner in the subject is, not to *unders nd*
what he is told, but to *believe* it. The look at
meets the expositor is a look of incredulity, nc of
blankness.

Consider for a few moments any of the p a-
doxes which have created the illusion that r a-
tivity is unintelligible. What is there difficul to
understand in the statement that if we watc a
man moving quickly we shall find that his cl ck
will not keep time with ours? Or that he ill
appear to have shrunk in the direction of mot n,
and we shall appear to have done so to him? ne
thing can be pictured by the dullest imaginati ;
any child who has seen a clock or a yardstick n
understand what it means. But it takes a cl ld
or a genius to believe that it would happen, and e
ordinary man, being neither a child nor a geni ,
does not believe.

Finding the proposition incredible, the ordina y
man thinks he must have misunderstood. The e
must be something he has not grasped, some u -
realised factor in the matter which, if it could l e
laid hold of, would remove the paradox and tal
the 'nonsense' out of the business; and because l
cannot find this mental philosopher's stone he co
cludes that he has not understood what he h
been told.

If this diagnosis of the situation is correct, son
modifications of the customary treatment are r
quired. Illustrations designed to show how tl
phenomena can be pictured in the mind—such
those involving the properties of spherical mirror
for example—become somewhat irrelevant. Ingenious and trustworthy though they may be, they merely illustrate what can be readily imagined without their aid, and so evade the main problem. Salvation must be by faith, and not by reason.

The aspirant must be persuaded that what seems too absurd and too simple to be the great principle of relativity is nevertheless just what he is seeking, and that he has already grasped it if he will only believe. Science is not often called upon to play the rôle of the 'hot gospeller,' but the teaching of relativity appears to furnish a situation in which, with some obvious reservations, it must do so.

The best mode of procedure has yet to be found but the first step seems fairly obvious. The learne must be assured that relativity involves nothin in the slightest degree inconsistent with ordinar experience. The source of his unbelief is un doubtedly his failure to distinguish between wha he has actually experienced and what he has bee in the habit of extrapolating from experience. Th paradoxes of relativity are concerned entirely wit the latter, but he unconsciously attributes them t the former, and so there arises in him an undefine feeling that there is something wrong.

The ordinary learner does not realise that h has previously had no grounds at all for com paring his view of the world with that of a observer travelling at half the speed of light. He thinks his preconceived view inevitably follow from his experience of smaller speeds, and when h learns that relativity is in conflict with that vie he thinks it must therefore be in conflict wit experience. Unfortunately, many of the popula accounts of the subject tend to foster tha belief.

The matter has a larger importance than th mere understanding of an abstract principle c science. It has a profound effect on the whol habits of thought of the person concerned. Onc let the possibility be admitted that knowledge i not firmly grounded in experience, and the min loses its anchor; "function is smothered in sur mise, and nothing is but what is not." Th moment a man, however humble and unspecialise he may be, loses the confidence to say, 'That i nonsense,' to anything which violates his experi ence, by whomsoever and in whatsoever name i may be pronounced, he has lost, if not his senses at least everything that makes them significant He has no longer any hold on the world, and ha become a potential victim to any delusion o absurdity that he may chance to encounter. Th most serious effect of the failure to realise the mean ing of relativity is the tendency to lapse into thi state of mind.

One or two examples must suffice. An articl appeared recently in a widely read journal, by a writer in many respects deservedly popular, in which the effect of relativity on our knowledge o the material world was discussed. It was statec that a piece of matter was no longer a "solid entity enduring through time," but had become indefin itely "attenuated," and was "a series of momentary existents which only their resemblances to one another justify us in collecting together as appear ances of the same thing." The id

was a "hard, tangible something" was stigmatised as "the horse sense of the materialist."

It is clear that the words used—"solid," "attenuated," "hard," "tangible," etc.—cannot be taken literally, or the absurdity of the statements would be too obvious. They are metaphorical, and the impression the passage gives is that the material world has lost its stability, that it would not be surprising if the moon, say, suddenly disappeared or turned into green cheese, since "a series of momentary existents" with "only" a resemblance to one another might possibly terminate or take on a new form. The simple fact, that in order to get a unique *measure* of any portion of the material world we must state its relation to time and space as well as its mass—a fact which violates no experience and leaves the 'hardness' or 'tangibility' of the material world exactly where it was before—is diffused into a nebulous, metaphysical vagueness which a moment's reference to experience would suffice to discredit. But perhaps the most significant feature of this matter is that, in a journal with no lack of critical correspondents, no note of protest was sounded. Apparently the magic word 'relativity' induced a kind of hypnotic state in which the subject passively accepted what he was told without regard to the facts of his everyday life. This is the natural result of the impression that relativity involves a denial of ordinary experience.

The reference to the 'materialist' suggests another common error, namely, that in some way relativity has killed 'materialism' as the word used to be understood. The essence of materialism is the belief that the physical world, which is apprehended by the senses, is the basis and source of consciousness. This belief is a deduction from experience, and those who really feel its force, whether they assent to it or not, know that it can be in no way affected by a change in units of measurement. The physicist may choose to speak of a stone as an 'event' instead of as a piece of 'matter,' because he has found a more fundamental way of measuring its content, but the stone as an object of sense-perception, with all the properties which have made it a challenge to idealism, is still there. The recognition of the challenge may be "horse sense," but it remains sense; and the opposite of sense is still nonsense.

Relativity represents a great advance of the vanguard of human thought. It is to be hoped that it will not result in a blind, chaotic drifting of the minds in the rear.

H. D.

The Secret of the Barnacle.

Barnacles in Nature and in Myth. By Edward Heron-Allen. Pp. xv + 180 + 8 plates. (London: Oxford University Press, 1928.) 15*s*. net.

THIS is a very delightful book, scholarly and whimsical, but it recalls just a little a reviewer's remark on a distinguished philosopher's "Secret of Hegel," that whether the author had understood the secret or not, the practical certainty was that he had kept it to himself; for after reading Mr. Heron-Allen's book we remain puzzled by the barnacle's secret—we mean, of course, its pseudo-secret, namely, its connexion with a goose. The real secret of the barnacle was solved by Dr. J. Vaughan Thompson in 1830 and 1835 in his famous researches, which showed what barnacles actually are and how they develop. On this point all zoologists are agreed; the puzzle is to explain how barnacles got mixed up for centuries with barnacle geese. We had expected that Mr. Heron-Allen's ingenious mind and sleuth scholarship would have cleared the mist away. The book is extraordinarily learned, and though we confess we never heard of most of the authorities he quotes, we suppose they are all right. The learning is certainly anything but dull, for even the footnotes, mercifully relegated to fifty pages at the end, have an undeniable sparkle. There is also a generous sprinkling of interesting illustrations, some as quaint as quaint could be.

What, then, is our ungrateful disappointment? It is that the learned author crowds down to three pages what seems to us the really interesting question: How did the barnacle myth arise and how did it persist for so many centuries? Perhaps, however, the author has done all anyone could; but in any case, after reading the book we are left rubbing our eyes; and Mr. Heron-Allen confesses or complains, in company, we are told, with Aeneas Sylvius Piccolomini, sometime Pope Pius II., that the myth, urgently pursued, has "fled ever further from investigation, like a will-o'-the-wisp."

The gist of the history is that from the early thirteenth century onwards it was circumstantially stated that barnacles developed into goslings. The belief was so widespread that in some religious centres barnacle geese were allowed at dinner during Lent because "they are not flesh nor born of flesh." To this primary confusion there was added a secondary fancy that the birds grow on trees "towards Ireland on the sea," and that they fall off when nearly mature, those that fall

on land coming to naught, while those that fall into the water swim off or fly off as geese. From the various accounts it is quite clear that this secondary absurdity was due to the fact that trees that had been flooded out to sea were sometimes tossed up again on the beach with barnacles attached. Although Vincent of Beauvais pointed out expressly that the bernacas "hang not from the ends of the branches, but from the trunks and the bark," this was not respected in subsequent woodcuts and descriptions. Hector Boece (*d.* 1536) indicates in regard to an Aberdeenshire tree that the barnacles it bore were engendered while the tree floated in the sea: yet even he continues to describe some of the little creatures as "perfect shaped fowls."

From a barnacled tree thrown up as jetsam it is easy to pass to one that grew near high tidemark, and we cannot help thinking that the interpreters have not made enough of the superficial resemblance between barnacles and papilionaceous flowers. Five shell-valves on the crustacean and five petals in the flower afford a good basis for further homologising, just as plausible as that between the six pairs of biramose and setose appendages and the feathers of a bird. Yet when all is said, it is puzzling that there should persist century after century the quaintly absurd linkage of tree and crustacean and goose. This is the more puzzling, since so early as the thirteenth century Albertus Magnus had practically punctured the myth by asserting that he and his friends had seen the barnacle goose laying eggs in the ordinary fashion. One may doubt whether he was right in his identification of the barnacle goose, the breeding places of which in the far north were not known to ornithology until the twentieth century, but Albertus certainly discarded the barnacle superstition. Yet it prevailed, and so late as 1661 we find Sir Robert Moray reading a paper before the Royal Society, describing the "perfect sea fowl" within the valves. About the middle of the eighteenth century people began to be ashamed of the story.

In explanation of the origin and persistence of the myth, it has been suggested that mystery shrouded the development of the barnacle goose and the ship barnacle. But there were very numerous similar gaps in knowledge which did not worry the medieval mind. It has also been pointed out that the ship barnacle is a very striking creature on a small scale, and that no one knew where to fit it in. Oftenest it was called a mollusc, which was not happy. But the objection is that it was too early for a zoological puzzle to evolve a myth for a not very obtrusive organism.

Mr. Heron-Allen rejects the etymological or philological interpretation that two similar words of different origin, such as barnclake (dark goose) and bernaca, became mixed up so persistently that people were forced to give the bird and the barnacle a genetic affiliation. Our author lays most stress on the resemblance between the curled feet of the Cirripede and a bird's feather; but this seems a slender basis for the superstructure. Perhaps it is fallacious to try to explain to ourselves how a Dark Age myth arose. We have to remember, what Dr. Singer has shown so well, that for many centuries men lost the ambition of making new knowledge and of seeing for themselves, and relapsed almost, if not quite, pathologically, into magical and superstitious ways of accounting for things.

The last chapter in the book deals with an interesting discovery made by the French zoologist Houssay and pursued by Sir Ray Lankester. It seems that on Mycenean pottery, perhaps 800 B.C., the evolution of a ship barnacle into a goose may be traced. Just as other objects, like fish, serpent, and swan, became in the course of generations of repetition conventionalised into mere symbols, so it looks as if a drawing of a ship barnacle with its stalk and its limbs may have gradually changed in the potter's hands into the image of a goose. It looks as if the barnacle had made a deep impression on the artistic mind! J. A. T.

Enzyme Research.

Die Methodik der Fermente. Herausgegeben von Carl Oppenheimer und Ludwig Pincussen. Lieferung 1. Pp. x + 320. Lieferung 2. Pp. vii + 321-624. Lieferung 3. Pp. vii + 625-944. (Leipzig: Georg Thieme, 1928.) 28 gold marks each.

FOLLOWING the publication of the fifth edition of Prof. Oppenheimer's well-known treatise, "Die Fermente und ihre Wirkungen," it appeared desirable to compile a companion volume describing the methods that have been devised in carrying out researches on the subject. There were two alternatives. The first was to prepare a concise volume giving merely an outline of these methods; the second was to prepare an extended treatise. Of these alternatives the latter was chosen, and the work has been carried out under the joint editorship of Profs. Oppenheimer and Pincussen, in collaboration with leading authorities drawn

from all parts of the world. The complete work will form vol. 3 of "Die Fermente und ihre Wirkungen."

The first three parts (*Lieferungen*) only of the work are before us, and it is estimated that the whole will be completed with the publication of two more parts. According to the table of contents drawn up by the publishers, the treatise will be divided into three sections, each subdivided into chapters written by specialists.

Section 1 deals with general methods, physical, physico-chemical, and chemical methods. Following this are chapters on the preparation of sugars, polysaccharides, glucosides, fats, proteins, etc. The last part of the section is devoted to the preparation and purification of enzymes and the measurement of their activity. Section 2 is concerned with the different classes of enzymes—esterases, carbohydrases, nucleases, amidases, proteases, desmolases, and fibrin ferments. The third part up to p. 944 concludes with the commencement of the chapters on amidases. Section 3, commencing with Part 4, will deal with the detection of enzymes in biological objects, and clinical enzyme methods.

Adverse criticism of the different chapters is to some extent disarmed by the fact that those responsible for the text have been well chosen, the majority being well known authorities on the subjects on which they write. When we come to review the work as a whole, or rather the three parts before us, the case is a little different. At the present time scientific literature has reached such dimensions that it has long been found necessary to call halt, and the most drastic condensation is now practised by the editors of our scientific periodicals in regard to communications. The same necessity arises in regard to treatises on scientific subjects, and here duplication ought to be avoided so far as possible. In a book like the present, dealing with methods applied to the scientific investigation of enzymes, the text should, in our opinion, be restricted to a description of methods which are specific to the subject and not common to other fields of research.

In the opening chapters of the present treatise, 243 pages of text are taken up with descriptions—admirable in every respect—of methods of polarimetry, refractometry and allied physical methods, spectrophotometry, colorimetry, viscosity and surface tension, osmotic pressure, the determination of hydrogen ion concentrations and of electrical conductivity, and of the micro-chemical methods of elementary analysis. These are all subjects dealt with in works specially devoted to them. Again, in the chapters dealing with the preparation and properties of substrata covering 185 pages, we find a lengthy account of the preparation and properties of sugars, starch, glycogen, cellulose, glucosides, fats, and proteins, such as would scarcely be expected in such a treatise as the present one. We are sorry to find in the chapter dealing with the sugars that some of the information is not up-to-date, whilst the structure shown of some of the sugars is credited to the wrong authority.

The chapters describing the isolation and purification of enzymes commence on p. 428 and are not completed in the third part. The matter in the text is, so far as can be judged from that which is before us, germain to the subject of the treatise, and is a welcome compilation to a branch of knowledge which much needed piecing together in a concrete form. The chapter on methods of adsorption and elution, of which subject Willstäter is the pioneer, if a little verbose, is exceedingly useful ; it covers 42 pages of text. The extraction of enzymes from animal and plant tissues and organs, and from yeasts and bacteria, is dealt with in a chapter entitled "General Treatment of Raw Materials for the Isolation of Enzymes," whilst another chapter is devoted to the isolation of enzymes from the lower cryptogams (including mould fungi) other than yeasts and bacteria. Following a short chapter on the culture of bacteria are others on the extraction of enzymes from plant tissues and seeds, and from the animal organs, whilst another describes the technique of operations for the isolation of secretions. The technique of methods for the manometric measurement of respiration and fermentation as well as for the measurement of the gas exchange during the aerobic and anaerobic respiration of plants, is dealt with in other chapters. The text dealing with specific enzymes commences on p. 701 and will be continued to the end of Section 2.

The few points alluded to will give some idea of the scope of the treatise and serve to indicate its general utility. There is no doubt that the work will be welcomed by the many and ever-increasing number of investigators who devote themselves to a study of that abstruse branch of chemistry concerned with enzymes. When the complete work is published, we shall be in a better position to deal with it.

In conclusion, we would throw out the suggestion that, following the example of Prof. Oppenheimer (who published a condensed edition of his first

larger treatise under the title "Lehrbuch der Enzyme"), the authors should prepare a similar condensed edition with all the important references retained in the case of the present treatise. Such a volume would be exceedingly valuable to students as a laboratory text-book. ARTHUR R. LING.

The Association of Higher Plants and Fungi.

Mycorrhiza: an Account of Non-Pathogenic Infection by Fungi in Vascular Plants and Bryophytes. By Dr. M. C. Rayner. (*New Phytologist* Reprint, No. 15.) Pp. x + 246 + 7 plates. (London: Wheldon and Wesley, Ltd., 1927.) 21*s.* net.

THE chapters of this volume are already familiar to botanists, having appeared in the *New Phytologist* of 1926–27, and being reprinted here with slight emendations. To the more general biologist the title of the book may suggest a somewhat technical discussion of a particular and restricted problem, but in reality, making intimate contact as it does with horticulture, forestry, mycology, plant pathology, soil science, plant physiology and general biology, its interest is unusually wide. Further, it is well written and may be perused with interest by the more general scientific reader.

The fact that numerous vascular plants show a regular and characteristic yet non-pathogenic infection by fungi has been known for many decades, but the critical study of this relation may be said to date from the researches of Frank in Germany about forty years ago. The first half of this period was devoted primarily to the study of the structural relationship between fungus and host, and the last two decades to analysing the more physiological and biological aspects of the relationship.

Interest in these latter problems received tremendous impetus from the researches of Noël Bernard on orchid mycorrhiza, and this interest continues unabated. The first few chapters of Dr. Rayner's volume give an admirably clear picture of the development of research on the subject, and the way in which an issue, originally of almost parochial interest, has become more vital and inclusive until now it touches fundamentally many subjects not only of theoretical but also of immense practical importance. Excellent accounts are given of the part played by fungi in the growth of orchids and the development of orchid cultivation, and the ways in which the natural relationship may be utilised or circumvented by commercial growers. Equally valuable is the author's discussion of the recent researches of Melin, Peyronel, Falck, and others on the ecological and physiological significance of tree mycorrhiza and the application of experimental results to field conditions and forestry. A particularly interesting chapter is that devoted to a consideration of the tuberisation theories of Bernard and his modern disciple Magrou, especially in relation to tuber development in the potato, and one cannot but agree with the author's tentative rejection of their validity.

In her last chapter, Dr. Rayner, who is the most distinguished English student of these problems and whose researches during seventeen years have added greatly to our knowledge of the mycorrhiza of the Ericaceæ, summarises her views on the symbiotic relationship, coming to the final conclusion that "the possession of mycorrhiza is frequently of benefit to the vascular hosts, the nature and extent of such benefit depending upon the physical conditions of the environment and the physiology of the association in individual cases."

The author has been to immense labour in bringing together the widely scattered information on her problem and has achieved notable success in her synthesis and presentation. Here and there one notes points which might be commented upon, more especially when the author is discussing the actual fungi. Thus, fungi of the "*Rhizoctonia* group" (p. 72) are quite common and plentiful in most soils, as are the 'pelotons' or skeins in varied and numerous species of fungi growing in pure culture. These are trivial details, however, and on the whole the volume impresses one as being an extremely accurate and balanced discussion of the problems of mycorrhiza. The plentiful illustrations, full bibliography, and adequate index complete a book the author may well be proud to have written. W. B. B.

Our Bookshelf.

Air Ministry: Meteorological Office. British Rainfall, 1927: the Sixty-seventh Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1927 as recorded by about 5000 Observers in Great Britain and Ireland. (M.O. 305.) Issued by the Authority of the Meteorological Committee. Pp. xvii + 290. (London: H.M. Stationery Office, 1928.) 15*s.* net.

THE volume of "British Rainfall" for 1927, which has just been published, is the sixty-seventh that has appeared since the British Rainfall Organization was founded by the late Mr. G. J. Symons in 1859, in order to standardise the methods of

measurement of rainfall in the British Isles and to provide a means of ensuring that the observations made by amateurs should be preserved and be made available for purposes of research and statistical inquiry. When it is considered that the Organization, in spite of every effort, does not secure the co-operation of all private observers, and that notwithstanding this limitation no fewer than 4970 records are published in this volume, some idea is formed of the valuable material that would be largely wasted every year without some such organisation. It is satisfactory to note that 97 more records have been secured than were available for the 1926 volume.

Turning to the facts about the year's rain revealed by this latest volume, it is noted that over the British Isles as a whole, an excess of rain was measured in 1927; this is the fifth successive wet year. This fact suggests that some climate 'surge' is in operation: the probability is 32 to 1 against such a run of wet years having arisen by 'chance.' Only four wetter years have occurred during the last sixty.

The general arrangement of the volume under review is similar to that of recent volumes. The heavy snowfall at Christmas in the south of England, after a considerable period during which the reputation of that season for snow has steadily declined, has inspired a special article by Mr. L. C. W. Bonacina on the snowfall of the half-century from 1876 to 1925. There is also a report by Mr. F. Hudleston upon experiments with raingauge shields: these experiments throw further light upon the problem of getting accurate measurements of rain in places unduly exposed to the sweep of the wind. There are in addition detailed discussions of cases of exceptional rainfall, and monthly, seasonal, and annual maps showing the distribution of rain over the British Isles for those periods.

Adsorption und Kapillarkondensation: Theorien der Adsorption und Kapillarkondensation von Gasen und Dämpfen an festen Oberflächen und in porösen Körpern. Von Erich Hückel. (Kolloidforschung in Einzeldarstellungen, herausgegeben von Richard Zsigmondy, Band 7.) Pp. vii + 308. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 20 gold marks.

IN this critical survey of the theories of the processes of adsorption, particular attention is directed to the limits of validity of the assumptions made in the various hypotheses, and the gaps between existing theories have been bridged by an application of the resources of modern physics. A unification of theory has been attempted, and the same basic principles have been applied to the whole range of adsorption phenomena. Irreversible processes—for example, chemical action—do not come within its scope; the knowledge of these branches is too incomplete to warrant the extension of the theory to them. The book has been written with the aim of its being intelligible to a public possessing no great mathematical knowledge.

The unifying principle is found in the idea that the effective range of molecular forces is less than the molecular diameter. This idea runs like a silver thread through the fabric of the book. Its substantial accuracy is demonstrated by a mathematical analysis of strength of the electrical field extending from the surface of a crystal of rock-salt and calculation of the heat of adsorption of dipole molecules by this surface. This analysis, as was shown independently by Lennard-Jones, leads to heats of adsorption of the correct order. The formation of a more or less complete monomolecular layer in processes of adsorption is a consequence of the rapid decrease in the strength of the electrical field at the solid surface.

The properties of this film are examined in detail over the whole range of surface density, and linked up with the processes of capillary condensation which occur when gases below their critical temperatures are adsorbed in porous bodies. A simple treatment of the theory is found to be adequate for the interpretation of the major experimental facts; minor deviations from the simple theory, however, are examined from the point of view of the dipole and quadripole nature of the adsorbed molecules and the electrical and Van der Waals' forces acting between them.

The volume stimulates the reader's interest in the complex interplay of molecular forces which give stability to the monomolecular layer on the surface of solids.

Artistic Creation and Cosmic Creation. By Prof. S. Alexander. (Annual Philosophical Lecture, Henriette Hertz Trust, British Academy, 1927.) (From the *Proceedings of the British Academy*, vol. 13.) Pp. 26. (London: Oxford University Press, 1928.) 1*s*. 6*d*. net.

THE usual theory of artistic creation is that the work of art, previous to its execution, "exists in the artist's mind as an image or intuition." In his Adamson lecture ("Art and the Material"), Prof. S. Alexander has already given reasons for believing that this conception is mistaken. On the contrary, the artist "does not in general first form an image (if he is a poet, say) of what he wants to express, but finds out what he wanted to express by expressing it; he has, in general, no precedent image of his work, and does not know what he will say till he has said it, and it comes as a revelation to himself." The work of art is "a material thing . . . dyed through and through with meanings, and these meanings sustained and supplied by the appreciating mind." Thus the essence of the work of art is that in it "creative mind and the material are indissolubly fused." But in applying the analogy of the arts to the universe, "we must discount the finitude of the partners in the transaction." The infinite, being infinite, can have nothing outside itself upon which to work as an artist works on his material. The finitude involved in art must be stripped off; we must abandon the idea of "a mind or spirit which precedes the world and creates it."

"We must look to the world in its simplest expression, and there we find something which

corresponds to the essence of art, the complete fusion in it of something that corresponds to mind and something that corresponds to material. . . . It is itself uncreated, but is merely there. In it as in a matrix are formed the finite things which are said to be created. . . . There is no creator of it except itself; but it is the creator of all finites that come into being within it. . . . God, therefore, though not the creator of the Universe, is, so far as He is identical with the universe, creator of all the things within it." J. C. H.

Electrical Engineering Economics: a Study of the Economic Use and Supply of Electricity. By D. J. Bolton. Pp. xi + 305. (London: Chapman and Hall, Ltd., 1928.) 21*s.* net.

THE study of economics is of great importance to everyone. We should all know something about capital and interest, and sinking funds and depreciation. The question is whether we should be taught this at school or at college, or whether we should pick it up in our everyday work. We have heard an eminent engineer wax indignant because he had met a university graduate who did not quite understand what crossing a cheque meant. Another complained that few, if any, technical graduates knew at what stage in the transaction a purchase was completed. In questioning a young salesman on this point, he replied that he had bought a 'business' dictionary to which he referred when in doubt.

The questions Mr. Bolton discusses, however, are not connected with law, except in so far as legal enactments limit methods of production or supply. It seems to us that the questions discussed are mainly concerned with finding out under what conditions we can supply most economically. Many of them are simply problems in finding maximum and minimum values, the solutions to which are sometimes difficult to find. Kelvin's problem, for example, which gives a method of finding the most economical size of conductor to use in supply, is given, and its limitations are explained.

These and many similar problems can often be solved, approximately at least, by graphical methods, and some of these methods are of practical use. We are not convinced, however, that it is necessary to make a special department of 'electrical engineering economics.' There is such an infinite variety of conditions of supply that it is impossible to comprise the solutions to all the problems that arise by means of formulæ.

Coloured Plates of the Birds of Ceylon. By G. M. Henry. With a short Description of each Bird by W. E. Wait. Part 1. Pp. v + 16 + 16 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd., 1927.) 30*s.*

IN 1925 Mr. W. E. Wait brought out a most excellent handbook of the birds of Ceylon, illustrated with a few black-and-white plates. At the time it was felt that the value of this book would have been greatly enhanced had it been possible to bring out a certain number of coloured plates to illustrate it, but this was unfortunately a financial impossibility. It was fully realised, however, by the authorities of the Colombo Museum and the author himself that such illustrations were most desirable, and in 1926 the generous help of Dr. Casey Wood made the publication of these plates possible. The painting of the plates has been entrusted to Mr. G. M. Henry, whilst Mr. Wait has supplied a brief précis from his manual as letterpress to each plate. The present part contains sixteen plates, and it is intended to complete the work in four parts, after which it is possible that a further volume may be published.

Taking them as a whole, the plates are excellent. The attitudes of the birds are life-like and vigorous, showing that the painter is well acquainted with their life-history as well as with their museum skins. Whilst the artist is not equally happy in all his efforts—as, for example, in the plates of the Brown-capped Babbler and the Black-capped Bulbul—we think he has been exceptionally successful in his beautiful plate of the Spotted-winged Thrush and Palliser's Warbler. We look forward to the second part of this publication with great pleasure, and if the work is maintained at the present standard, it will undoubtedly be a great addition to the zoological literature of Ceylon and a worthy successor to Legge's great work.

Geheilte Knochenbrüche bei wildlebenden und in Gefangenschaft gehaltenen Tieren. Von Prof. Dr. E. Korschelt und Dr. Hermann Stock. Pp. iv + 176. (Berlin: Gebrüder Borntraeger, 1928.) 24 gold marks.

THE healing of fractured bones in wild animals (mammals, birds, reptiles, and amphibians) reveals the astounding adaptability of the natural forces of repair and the extent to which widely separated fragments can be joined up under natural conditions without the surgeon's assistance. The book is illustrated by numerous photographs and radiographs. In the bibliography of fifty-eight titles, fifty-six are German and none of them British, although, from the time of John Hunter, British anatomists and surgeons have taken special interest in this subject.

Aus dem Leben der Bienen. Von Prof. Dr. K. v. Frisch. (Verständliche Wissenschaft, Band 1.) Pp. x + 149. (Berlin: Julius Springer, 1927.) 4·20 gold marks.

THIS excellent and attractively produced little volume stands out in refreshing contrast with most elementary books on bee life, since it is the product of the author's original researches. Dr. K. v. Frisch is well known as an expert experimenter through his observations on colour sense, methods of recognition, feeding responses, and other features of the sense physiology of the bee. The book is to a large extent a summary of these researches, and we commend it to all interested not only in bee life, but also in general animal behaviour.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Short Wave Echoes and the Aurora Borealis.

ON Feb. 29 of this year I received a letter from Engineer Jørgen Hals, Bygdø, Oslo, in which he says: "I herewith have the honour to advise you that at the end of the summer 1927 I repeatedly heard signals from the Dutch short-wave transmitter station PCJJ (Eindhoven). At the same time as I heard the telegraph-signals I also heard echoes. I heard the usual echo, which goes round the earth with an interval of about $\frac{1}{7}$ second, as well as a weaker echo about 3 seconds after the principal signal had gone. When the principal signal was especially strong, I suppose that the amplitude for the last echo 3 seconds after lay between $\frac{1}{10}$ and $\frac{1}{20}$ of the principal signal in strength. From where this echo comes I cannot say for the present. I will only herewith confirm that I really heard this echo."

Immediately I heard of this remarkable observation, it struck me that the wireless waves were reflected from those streams and surfaces of electrons to which I was led by theoretical investigations on the aurora borealis in my paper published in 1904 in *Videnskabsselskabets Skrifter*, Christiania ("Sur le mouvement d'un point matériel portant une charge d'électricité sous l'action d'un aimant élémentaire.") In reference to that paper, and the subsequent more complete one in *Archives des Sciences physiques et naturelles*, Geneva, 1907, one of the most striking features of the theory was that streams of electrons coming from without towards the earth were deviated by the earth's magnetic field in such a way that an immense space was formed free from electric particles, and having the shape of a torus described by revolution of an oval tangent to the magnetic axis of the earth at the centre. These results were also in full agreement with Kr. Birkeland's remarkable experiments with cathode rays directed towards a magnetic sphere, described in 1901 in *Videnskabsselskabets Skrifter* ("Expédition norvégienne de 1899–1900 pour l'étude des aurores boreales"). If now the wireless signals could penetrate the Heaviside layer, they would pass into this empty space, and might be reflected by the walls of the electrons forming its outer boundary. The long time interval between the principal signal and the echo agrees well with the immense dimensions of these toroidal spaces.

It was now very interesting to me to obtain more evidence of these remarkable echoes, and last spring and summer I organised a long series of observations, for which I am very much indebted to Dr. van der Pol, at Philips Radio, Eindhoven, for his very efficient work in sending signals, and further to Elektrisk Bureau, Oslo, to the Norwegian Telegraph Administration, and to Engineer Hals, for aid in arranging the reception of the signals. The observations were continued during October, but no certain evidence was obtained before Oct. 11. Eindhoven emitted during the afternoon very strong signals of undamped waves of wave-length 31·4 metres, and Hals and I heard very distinct echoes several times, the interval between signal and echo varying between 3 and 15 seconds, most of them coming about 8 seconds after the principal signal. Sometimes two echoes were heard with an interval of about 4 seconds. I immediately telegraphed the success to Dr. van der Pol at Eindhoven, and asked him to control and verify the effect. Next day I received the following telegram:

"Last night special emission gave echoes here varying between three and fifteen seconds stop fifty per cent of echoes heard after eight seconds stop van der Pol."

After this it seems that we have here a new and remarkable phenomenon, the study of which may throw much new light on the electric currents in space outside the earth and on their connexion with the aurora borealis and magnetic storms. The variability of the phenomenon indicated by the observations agrees well with the corresponding variability of aurora and the magnetic registrations.

CARL STØRMER.

The Expansion of Charcoal accompanying Sorption of Gases and Vapours.

IT has been emphasised in a recent paper (Bangham, *Phil. Mag.*, 5, 737; 1928) that our knowledge of the sorption process must necessarily remain incomplete so long as attention is focused solely on the behaviour of the gas or solution, to the entire neglect of any concomitant effect on the solid sorbent with which it is in contact. It was shown by Meehan (*Proc. Roy. Soc.*, A, 115, 199; 1927) that even such a rigid structure as a block of charcoal expands considerably when taking up carbon dioxide, the expansion being of the same order as the water-movements of building materials as determined in the experiments of Stradling. From the theoretical point of view the effect is discussed in broadest outline in the first of the papers mentioned, but it is clear that much experimental work is necessary before a fully developed theoretical treatment is possible.

A modified form of Meehan's apparatus, made to our design by Messrs. Becker, has enabled us to make some preliminary measurements of the linear expansion of charcoal which has sorbed known weights of water vapour at pressures short of saturation. It was found that the expansion is not—as one might have supposed—directly proportional to the quantity of vapour sorbed, but that the curve obtained on plotting the variables is concave to the *expansion* axis, even in the region where the pressure of vapour is a considerable fraction of the saturation pressure. Apart from providing fairly direct evidence—if such were lacking at this stage—for the chemical, as opposed to the capillary-condensation theory of sorption at such pressures, this fact appears to throw considerable light on the question of the usual form of sorption isotherm, since it indicates that the mechanical disturbance suffered by the solid during the sorption of a given quantity of gas becomes greater and greater as the sorption proceeds.

It is remarkable that, within experimental error, the expansion is directly proportional to the *square* of the sorption value. The data obtained for carbon dioxide are also in substantial agreement with this relation; they are, however, subject to certain corrections which can be estimated with accuracy only when the apparatus is cut down. The following table gives a summary of the results so far obtained:

	Water.			Carbon Dioxide.		
	s.	η.	$\frac{\sqrt{\eta}}{s}$.	s.	η.	$\frac{\sqrt{\eta}}{s}$.
Increasing sorption series	2·22	0·056	0·106	0·900	0·087	0·326
	5·18	0·226	0·092	1·227	0·149	0·315
	6·83	0·416	0·094	1·418	0·177	0·297
	8·59	0·626	0·092	1·557	0·232	0·309
	8·96	0·689	0·098	1·848	0·295	0·294
				1·980	0·338	0·293
Decreasing sorption series	7·40	0·475	0·093			
	5·78	0·231	0·095			
	4·21	0·139	0·089			

s = Sorption value in milligram molecules.
η = Expansion in arbitrary units.

No special attention was paid to the absolute measurement of the expansion, but a knowledge of the dimensions of the apparatus enables a rough comparison to be made with Meehan's results under corresponding conditions. The percentage linear expansion found by us to be caused by an atmosphere pressure of carbon dioxide works out at about 0·101 at a temperature of 30° C. Meehan found the percentages at 28° C. and 36° C. to be respectively 0·1292 and 0·1100 in the case of the pinewood charcoal used by him.

It will be observed that the quotient $\sqrt{\eta}/s$ is, on an average, rather more than three times greater for carbon dioxide than for water, so that the expansion caused by the sorption of any given number of molecules is between ten and eleven times as great in the one case as in the other. The difference is quite out of proportion to the difference of molecular size, whatever method is used as a basis of comparison.

While it is scarcely likely that the square-root relationship will prove to be of general application, it is at least significant that two substances so different in their general behaviour towards sorbents as carbon dioxide and water should both show this simple regularity. Experiments with other sorbents and sorbates are being proceeded with.

D. H. BANGHAM.
NAZIM FAKHOURY.

Egyptian University, Cairo.

Hamilton-Buchanan's Drawings of Indian Fish.

IN NATURE of May 12, p. 770, the following statement was made under "Research Items" in directing attention to my recent work on the MS. drawings of Indian Fish (Ham.-Buch. Collection): "In the first volume there are 22 plates of fish illustrations, representing 51 species, and the rest of the plates are of mammals; the second and third volumes are drawings of birds made by Mr. Gibbons; and the fourth are those of fishes, representing 150 species." I am afraid the writer of these notes has given wrong information. In the first volume there are only twenty plates of fish, and while in the second and third volumes there are some drawings by Mr. Gibbons, the majority of the plates are Buchanan's. The fourth volume contains delineations of 144 species.

I have now examined Buchanan's fish drawings preserved in the libraries of London with interesting results. Through the kindness of Lieut.-Col. R. B. S. Sewell, I have with me the Zoological Survey set (copies recently made) of the drawings in the Asiatic Society of Bengal. There is no doubt that the original drawings, of which Buchanan was deprived at the time of his departure from India in 1815, are those now in the possession of the Asiatic Society of Bengal. I have found a statement in Buchanan's own handwriting that he was not allowed to bring with him drawings of 144 species of fish. It seems to me certain that only 138 out of the 146 drawings listed by Day in vol. 4 (*Proc. As. Soc. Bengal*, pp. 195-209; 1871) are the originals which Buchanan left behind him. Drawings Nos. 34, 53, 62, 63, 64, 70, 71, 84 have been added afterwards to this set. The drawings of *Cyprinus chola* (Pl. LVIII, Fig. 3) and *C. dancena* (Pl. LV, Fig. 4), figured by McClelland, were missing when Day examined the set in 1871. There are four drawings in vol. 1, the originals of which are missing from vol. 4, namely, *Cheilodipterus panijus*, *Mystus chitala*, *Cyprinus curchius*, and *Cyprinus chagunio*. This gives us the original number of drawings belonging to Buchanan's collection—138 + 2 + 4 = 144.

In the library of the India Office are now preserved the originals of the drawings reproduced in the "Gangetic Fishes." In the same volume are five other drawings which were not used by Buchanan. These represent the following species: *Macrognathus armatus*, *Cyprinodon cundinga*, *Clupea purava*, *Mystus kapirat* and *Cyprinus sarana*.

In the library of the Linnean Society there are nine original drawings of Buchanan (probably out of a set of ten, one missing now), accompanied by the descriptions of ten species in Latin. These were sent by Buchanan to his friend Smith, the founder of the society, in 1799. All these nine drawings are figured in the "Gangetic Fishes," no doubt from the replicas of these very drawings.

The set referred to by Günther in the *Zool. Rec.* for 1869 is nowhere to be found in the British Museum (Nat. Hist.). It is probable, however, that Günther was referring to a large number of copies of Buchanan's manuscript fish drawings in the Calcutta and the India Office collection made by Major-General Hardwicke, and bequeathed to the Museum. Identifications in Günther's handwriting are to be found below some of these drawings, while the others bear references to "Gangetic Fishes" in Hardwick's handwriting. Some of these have been published, unfortunately without acknowledgment, in Gray's "Illustrations of Indian Zoology." Attention may also be directed to two or three copies of Buchanan's drawings among a set of Day's fish delineations, now preserved in the library of the Zoological Society of London.

These drawings are of special interest, for it seems to me likely that, in his descriptions of the Gangetic fishes, Buchanan greatly relied on them for the specific characters, at least in the case of quite a number of species. Thus, in the absence of any authentic types, these drawings may be considered as the types of the species described by Buchanan.

SUNDER LAL HORA.

British Museum (Nat. Hist.),
South Kensington, S.W.7.

Life and Sea Water.

THE leading article in NATURE of Oct. 6, p. 501, and Prof. F. G. Donnan's discourse, p. 512, recall attention to the conditions under which life may possibly have originated. This provides a certain playground for our ideas, romances, and inquiries; a playground with boundaries and with regions of special interest.

If blood-heat is about 35° C., or a little more in birds, and the optimum temperature for plant life about the same, this turns our thoughts away from the chill shores of north-east England to some tropic coast where rock pools may lie in hot sunshine between tides, evaporating and concentrating. The roughly 3 per cent solution we know as sea water is rather weaker than the 5 per cent normal saline of the physiological laboratory, where one must think of osmotic equilibrium or plasmolysis between tissue and fluid. Not that the density of the salt solution is the only thing that matters. Field and garden crops thrive best on a rather different mixture of salts demanding artificial additions of potassium, phosphates, and nitrates. How could such a nutrient solution have arisen under natural conditions?

When sea water evaporates, the contained substances are deposited, and in a certain order; some substances come out more readily, others less rapidly, than sodium chloride. Chapters of this order of deposition are recorded in the deep-sea floor, in the English Permian and Trias rocks, in the Stassfurt salt deposits, and in the terraces above the Dead Sea. There are manganese deposits in the deep sea, also

silica and calcium carbonate. Silica and calcium carbonate come out as diatoms and foraminifera; sea water must be about a concentrated solution of these. Iron compounds and gypsum begin to come out before rock salt; the mother liquor saturated as to iron, calcium sulphate, and sodium chloride, still contains potassium, magnesium, bromides, and iodides. With concentrating liquors double salts appear—magnesium-potassium sulphates and chlorides, substances like kainite and carnallite. Their philosophy and the equilibrium conditions of their crystallising solutions are worked out by van 't Hoff. These are the potash salts so valuable as artificial fertilisers. Carnallite need not be despised in theory because too deliquescent to handle in practice.

If these fertilisers cherish life now, may they not have been essential conditions for the origin of life?

The rusting of iron depends on air, moisture, carbon dioxide, conditions curiously like those of life; further, rust is encouraged by ammonium chloride, discouraged by potassium cyanide. May we postulate meteoric or other metallic iron?

If colloidal iron or silica forms a framework within which processes like life processes may arise, must we not look for conditions under which they might form in Nature? May we not regard all integrations—precipitation, crystallisation, double-salt formation—as stages towards life? Huxley pointed out that the essential life processes were formations of more solid substances from liquid or from gas.

A crystal begun in a solution of one alum may go on building itself up in another. Iron or aluminium may continue the work begun by chromium or manganese, ammonium may continue potassium. How do we know that life is not a sort of chemical habit? Long before chlorophyll or hæmoglobin were evolved, complexes may have been initiated by copper or nickel or manganese, afterwards to be inherited by iron. Sodium silicate is conspicuously absent from collections of natural minerals. Where has it all gone? It almost must have been formed in the pre-geologic era and washed out afterwards.

Pools by a tropic seashore would be liable to dilution from rain and from streams as well as to concentration; and streams from a volcanic island might bring in many sorts of substances, including ammonia compounds; hot springs bring silica in solution. Hence all kinds of oscillating conditions may be postulated, and life involves such oscillations. With concentrating solutions cells divide, seeds ripen; with dilution cells swell, antherozoids escape, seeds sprout.

Darwin said, at most four or five ancestors for all living things; but may we not imagine many and various just not successful attempts at life, combinations just not viable, an almost infinite number of collateral ancestors who have left no descendants? Only a hint of other possible chains of chemical reactions in the iron and sulphur bacteria and all the specialised cells in the glands of higher animals.

HUGH RICHARDSON.

Stocksfield, Oct. 7.

Proposal to Establish a Size Limit for both Salmon and Sea Trout in the Baltic.

IN vol. 48 of *Rapports et Procès-Verbaux des Réunions* of the Permanent International Council for the Exploration of the Sea, recently published, six writers, each representing a country abutting on the Baltic, give accounts of the salmon and sea trout fisheries, and in one case, that of the Swedish biologist Gunnar Alm, particulars of the early river life and of the sea life of a considerable number of salmon are given (presumably from scale reading).

It is clear that *S. salar* in the Baltic, as in British waters, may remain one, two, three, or four years in the sea before ascending fresh waters to spawn; that fish from widely separated rivers mingle in their sea life, and that on this account very different sizes are caught together; and it also appears that small immature fish are taken in the spring off the shallow coasts of Sweden.

Drs. Andersson and Johansen summarise the results, note that the Baltic salmon fisheries are now being conducted more intensively than in former years, and that the stock of fish is seriously declining. They state that in any international action for the preservation of the fisheries, the first consideration is to allow more fish to ascend fresh waters to spawn, and that "the imposition of a size limit is designed as a means to prevent the capture of small salmon and to give the salmon an opportunity to spawn."

It is with some amazement, therefore, that one reads the recommendation that the size limit be 35 cm.

A fair number of sea trout under 14 inches are sexually mature, but no salmon can be expected to spawn at so small a size, in spite of the fact that a few precocious male smolts are found from time to time. The remarkable thing is that the figures supplied by Alm are themselves amply sufficient to show how futile for the purpose stated a size limit of 35 cm. would be.

If there is a desire to increase the numbers of potential spawners in the rivers of the Baltic, why decree that all the salmon of spawning size may be killed? If the exigencies of the fisheries or the established practices of the fishermen make it difficult to recommend a larger size limit, it would appear that regulative treatment by size limit should be abandoned.

From the fact that fish of all sizes are caught together, but more particularly from the fact that salmon commonly spawn quite late in life and when more than twice the length of 35 cm., and that very many fish spawn only once in their lives, it should be clear that regulative treatment by size limit is not suitable.

Might I say further that experience in other countries has gradually brought about a recognition of the guiding principle that the sea is the place where, with suitable regulation as to mesh of nets and means of capture, salmon and sea trout may be freely taken, and that the river is the place where those fish reproduce their species, and where, therefore, they should be protected from capture, or at least from such commercial fishing as would prevent a proportion of every run of fish getting past the nets allowed, and so reaching the spawning areas.

W. L. CALDERWOOD.

Edinburgh, Sept. 27.

Birth of Adders in Captivity.

THE adder (*Vipera Berus*) has her young about the end of August and the first week in September. The gestation period is 4½ months. It is unusual for a herpetologist to have a captured snake giving birth to young immediately after being caught, but such has been my experience on two occasions, the first on Aug. 29, 1905, and the second quite recently, on Oct. 1, 1928, the latter birth being on a later date than normal. The adder in this case was a healthy specimen measuring 23 inches in length. On being caught I noticed that it was a bit sluggish and lethargic in its movements, making very little effort to escape. There was nothing in its contour to suggest pregnancy beyond being slightly corpulent, and I was certainly very much surprised to find on opening its cage one morning eight days after

capture a brood of eight young adders. They measured 4½ inches in length and six are females and two males.

The young adders were all normal specimens except one, which had malformation of the maxilla and palate. It was not so active as the others, which very soon after birth developed a marked biting tendency. The viciousness of these creatures prompted me to test their toxicological properties. So I got them to bite an ordinary microscopic slide, when I found that no secretion was produced until the third day after birth. I mixed some of the venom with fresh pig's blood, and microscopic examination of the slide revealed that the blood underwent a comparatively rapid hæmolytic and agglutinative change, indicating that the poison in this short period had acquired its maximum potency.

This in itself is an interesting observation and worthy of being placed on record, since it established that the degree of virulence of adder's poison is not proportionately in keeping with the degree of the physical development of the creature.

I have said in another place that adders will not feed in captivity, but I thought that these youngsters might be induced to take food, because in their case they had no knowledge of the freedom of wild life: their world was circumscribed by the confines of their cage. One would therefore imagine that they would respond to Nature's call for sustenance; consequently I made special efforts to coax them to take suitable nourishment, but my efforts were fruitless: they stolidly refused to touch a morsel of food.

Mother and family are still alive and well; for adders will live for a long time without taking any food. The hibernation period begins early in October, and although it is now the 22nd of that month, these creatures show no sign of becoming sleepy or torpid. Adders will not hibernate in captivity.

I should like to mention that the female adder did not show any maternal instinct towards her offspring. This may have been due to the reptile being in captivity.

N. MORRISON.

Beith Place,
Campbeltown, Argyll.

Components of Air in Relation to Animal Life.

OXYGEN, since the time of Lavoisier, has been considered the vital component of the air: the 79·19 per cent inert part has had little use assigned it. Popular opinion had stated that animal life would be more efficient if these inert gases were replaced by oxygen. Carefully conducted experiments covering a period of six years have shown the following facts in regard to animal life and the components of the air.

Animals cannot live in an atmosphere of oxygen, nitrogen, carbon dioxide, helium, or argon alone. A series of thirty experiments, using representative varieties of animal life, has shown that in an atmosphere of pure oxygen with other conditions normal, life would cease after two to five days. As could be expected, the inert gases would not support life.

An examination of the lung tissue from a guinea-pig which had died in an atmosphere of pure oxygen showed marked evidences of inflammation and interstitial hæmorrhages. Cultures made from the lung tissue showed a heavy infection of *Bacillus coli* associated with a few staphylococci. The conclusion drawn from the autopsy was that an atmosphere of oxygen should not only rupture the lung tissue but also accelerate the growth of certain micro-organisms.

Animals were placed in an atmosphere of 99·97 per cent oxygen and the normal 0·03 per cent carbon dioxide. Death followed within two to five days as in the oxygen experiments.

An atmosphere was prepared which contained 87 per cent argon and 13 per cent oxygen. Mice lived forty-two hours under this condition. The respiration of the animals decreased slowly until death.

Argon 80 per cent and oxygen 20 per cent permitted life for ninety-two hours.

Argon 75 per cent and oxygen 25 per cent supported normal life. After ten days of confinement the animals appeared in better health than before the experiment. An atmosphere made up of 66⅔ per cent argon and 33⅓ per cent oxygen supported life. The animals after seven days' confinement were in poor health. The point of highest efficiency had apparently been passed. Helium 79 per cent and oxygen 21 per cent form an atmosphere under which animal life may exist normally.

The high specific gravity, 1·38 (air), of argon gas, probably accounts for its behaviour as an oxygen diluting agent. Experiments must be carried further before a scientific conclusion can be reached.

The preparation of synthetic atmosphere has practical applications in the field of aviation. Tubes of compressed oxygen and helium may some day furnish the respiration gases for high flying.

The study of the physiological effects of the air gases has only begun. The experiments will be carried further before an attempt is made to interpret the data thus far gathered.

J. WILLARD HERSHEY.

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Spectra of Intermetallic Compounds.

DURING the last few years it has been established, on the basis of spectroscopic and other evidence, that certain metals, for example, the alkali metals and mercury, are capable of forming di- or poly-atomic molecules in the vapour state. It is also known that the vapours of certain pairs of metals (for example, sodium-potassium, rubidium-cæsium, and their analogues, also magnesium + alkali, and mercury + alkali) contain molecules of volatile intermetallic compounds. Both types of molecule are most conveniently studied by their absorption spectra, and most of them have been discovered in this way.

The great sensitivity of the spectroscopic method renders it necessary, however, to proceed with caution, as band spectra due to unexpected impurities frequently make their appearance, and are often difficult to identify. Errors of this nature would appear to have entered into recent work on the band spectra of zinc, cadmium, and mercury (Mohler and Moore, *Jour. Opt. Soc. Amer.*, vol. 15, p. 74; 1927), and also into an investigation of mercury-thallium and indium-cadmium mixtures (Waring, NATURE, vol. 121, p. 675; 1928; and *Phys. Rev.*, vol. 32, p. 435; 1928), as the same spectrum has been assigned two different origins—neither of them the true one—by the two different investigators. The greater part of the 'mercury-thallium' spectrum described in the latter papers is identical with one listed (though with some reserve) in the former under the heading of the 'cadmium' molecular spectrum. The true origin of this particular band system would seem to be the molecule of thallium chloride, as it is magnificently developed in very dilute vapour of that salt, under conditions precluding the presence of free metal. Similarly, the 'indium-cadmium' spectrum of Waring would seem to coincide with another set of 'cadmium' bands found by Mohler and Moore. The wave-length agreement is

not so perfect as it is for the previous systems, but the bands are very diffuse and are difficult to measure. We have also experimented upon the conditions under which these bands are developed, and since they are eliminated by additions of small quantities of alkali metals to the vapours, and are enhanced by additions of oxygen, we conclude that they may arise from an association of cadmium and oxygen. From experiments now in progress, however, we suspect that they may be totally unconnected with cadmium, and that another and unidentified impurity is responsible for them.

We hope that a complete account of these and other experiments will shortly appear elsewhere. It is, unfortunately, not possible to include a wave-length comparison in this letter, for reasons of space; but it may be stated that the agreement is so good that there can be no doubt of the identity of the spectra.

J. M. WALTER.
S. BARRATT.

University College, London,
Oct. 12.

Contractions for Titles of Periodicals.

OWING to absence from London I have only now seen Mr. Gomme's letter in NATURE of Sept. 22. I believe that among experts there is fuller agreement than either Mr. Gomme or the compilers of the "World List" would seem to admit on some of the rules which should govern the abbreviations of titles of scientific periodicals. Few, I think, would dispute the rules (*a*) that in an abbreviated title the abbreviations should follow the same order as the corresponding words in the full title of a journal as it appears on title-page or cover; and (*b*) that in a system of abbreviations the same contraction should not be called on to do duty for words of entirely different meaning. In my letter to NATURE of Aug. 25 I gave examples of what appeared to me to be infringements in the "World List" of both these rules.

Mr. Gomme seems to regard these infringements as unimportant so long as a searcher is able to consult at first hand the "World List," and has familiarised himself with its admitted vagaries, and possesses also a good knowledge of the titles of scientific periodicals to help him out in obscure cases. In thus advocating the "World List," Mr. Gomme overlooks the fact that when one is considering the universal adoption of a system of abbreviations for titles, regard must, in the first instance, be had to the requirements of scientific readers of all nationalities, of whom few will have ready access to the "World List," and still fewer will enjoy facilities that are at the command of a librarian of a large institution. To such readers the observance of the rules set out above, and of others which I have indicated in my letter of Aug. 25, is, I think, important. In their interest I would urge the soundness of yet another rule, laid down some years ago at the conference held in connexion with the International Catalogue of Scientific Literature, that abbreviated titles must be intelligible without a key.

R. L. SHEPPARD.

Bureau of Hygiene and Tropical Diseases,
23 Endsleigh Gardens, London, W.C.1,
Oct. 15.

The Contraction of Pachyphase Chromosomes in *Lilium*.

IN the pachyphase of *Lilium pardalinum*, in specimens fixed with chromic-acetic-formaldehyde, and stained with iron-brazilin, there were estimated to be 2193 chromomeres, each usually consisting of two pairs of chromioles. The average diameter of the chromioles was estimated at 0·23 micron, and the average distance between the centres of neighbouring chromomeres was calculated as 0·67 micron. Hence it could be deduced that an approximation of the chromomeres until they were in close contact would decrease the total length of the bivalents from 1469 microns at pachyphase to 504 microns (at diplophase). But in *Lilium longiflorum*, the maturation divisions of which closely resemble those of *L. pardalinum*, the total length of the twelve bivalents at late diaphase and at metaphase (and also the total length of twelve of the split anaphase chromosomes) was only about 150 microns.

This remaining contraction, to less than one-third of the minimum size which could be attained by approximation of the chromomeres, was presumed to be probably brought about by zigzagging of the chromonema, or chain of chromomeres. Since the volume of chromatin was shown by measurements to increase to about ten times its bulk between pachyphase and metaphase, this zigzagging was not directly visible; but it was indicated by the corrugation of the chromosomes at all stages from late diplophase to first anaphase. The total contraction in length, from pachyphase to first metaphase, was found to be about the same in *Aloe purpurascens* as in *Lilium*.

JOHN BELLING.

Carnegie Institution of Washington,
Department of Genetics,
Cold Spring Harbor, N. York, U.S.A.,
Sept. 27.

The Depth of Field and Resolving Power of Optical Instruments.

IN his letter in NATURE of Oct. 27, Mr. T. Smith repeats in a slightly different form the matter contained in my letter in the issue of Oct. 13. If the wave-length were infinitesimal the geometric theory would be correct. With a finite wave-length it 'pays,' so far as definition is concerned, to reduce the lens aperture until the 'spurious disc' and the 'circle' of confusion due to part of the image being out of focus are of the same order. Airy's work relating to the 'spurious disc' is contained in a paper entitled "On the Intensity of Light in the Neighbourhood of a Caustic." This I read in 1871. In reference to the same subject, the late Lord Rayleigh quotes Verdet's "Leçons d'optique." This I have not seen.

Mr. Beck states (p. 650) that 'etched' lines at 140,000 to the inch have been resolved and seen by the eye. If the lines are etched it is certain that the surface is not flat, but grooved, and no doubt the depth of the grooves is sufficient to alter the length of the wave path enough to effect resolution.

A. MALLOCK.

9 Baring Crescent,
Exeter.

Salmon and Sea Trout Synonyms.

MY attention has been directed to your comments, on page 547 of NATURE of Oct. 6, on my collection of local and general names applied to salmon and sea trout. The article to which reference is made was merely an attempt in the first place to clear up some of the superfluities of popular nomenclature and local idiosyncrasy, which you rightly condemn; and secondly, to collate and preserve them in the interests of philology. Whilst admitting that the list would have been much increased in value had the area in which each name is used been indicated, it is regretted that this would not be feasible, owing to the fact that many of the terms are used in the same sense throughout the country.

ALBERT WADE.

A 200-inch Telescope.

WE are informed by Science Service, Washington, D.C., that what will be the world's largest telescope, with a concave mirror two hundred inches in diameter—twice that of the greatest existing instrument—will be under construction within a few months. This important announcement was made at the California Institute of Technology on Oct. 29. The funds will be provided by the International Education Board of New York, which administers some of the Rockefeller benefactions. "The interest of the Board is based chiefly upon the successful co-operation of the Mount Wilson Observatory and the California Institute, and their belief that the provision of additional means of furthering this joint work may lead to many new advances in astronomy, physics and chemistry," it was stated. "The full co-operation of the Carnegie Institution of Washington, of which the Mount Wilson Observatory is a branch, has been assured by the unanimous action of President John C. Merriam and the executive committee of the Institution, and by that of Director Walter S. Adams and other members of the Mount Wilson staff. The research policy of the new Astrophysical Observatory of the California Institute, which will be designed to supplement and not duplicate the Mount Wilson Observatory, will be determined by a joint committee representing the two institutions, aided by other leading investigators."

Dr. George Ellery Hale, honorary director of the Mount Wilson Observatory, and chairman of the Observatory Council of the Institute, described the plans on Oct. 29 in an exclusive interview to Science Service. "In designing this instrument," he said, "we shall have the collaboration of leading physicists and engineers as well as of astronomers and instrument makers. When the telescope is completed it will be used to extend our present researches in various directions, as in spectrum photography of the stars, direct photography of very faint celestial objects, and in radiometry, or the measurement of the heat from the stars. By making a special study of the various instruments and methods to be used in conjunction with the new telescope for these and other purposes, and by securing the co-operation of the ablest authorities, we expect greatly to increase the efficiency of the telescope.

"The equatorial mounting of the telescope will be designed by a group of experts, including Dr. J. A. Anderson, Dr. Francis G. Pease, and other members of the staff of the Mount Wilson Observatory, working in conjunction with several eminent engineers, opticians, and physicists. It is the great mirror, nearly 17 feet in diameter, double that of the largest that has yet been made, that will offer the most difficulty. We expect to make it out of fused quartz, and are much pleased by the cordial and generous offer of co-operation received from President Gerard Swope of the General Electric Company and Dr. Elihu Thomson, director of the Thomson Research Laboratory of this Company at West Lynn, Mass. Dr. Thomson is deeply interested in the problem, and has already succeeded in making quartz discs of considerable size. His method is to cast a quartz disc full of fine bubbles and to fuse a layer of very pure quartz, free from bubbles, on the surface, in which to grind the proper dish-shaped figure. Such a mirror behaves as well as a perfectly solid one, and has the advantage of being lighter.

"The great advantage of quartz is that it changes its form so slightly with temperature. With the 100-inch telescope now at Mount Wilson we must always be careful to avoid exposing the glass mirror to the heat of the day, and some changes often occur due to differences in temperature at night. With a quartz mirror the effect of temperature is too slight to give any trouble. We feel confident that by the time we are ready for the mirror, Dr. Thomson will have succeeded in making a quartz disc of the requisite size. Pyrex glass, which is much better than ordinary glass but not equal to quartz, might be used as a substitute if necessary."

Just how long it will be before the new telescope is in operation, it is at present impossible to tell, but it will doubtless be several years. The plans for the 200-inch telescope have no connexion with the project of Prof. George W. Ritchey for a large telescope at the Grand Canyon, in Arizona. Prof. Ritchey has been working in Paris for several years on a method of constructing large telescope mirrors in a cellular fashion, but it is not planned to employ his method in the 200-inch.

The exact location of the new telescope also remains to be decided. Perhaps it will be placed on Mount Wilson (5900 feet altitude), where there would be the advantage of proximity to the other observatory facilities. However, it is possible that the smoke, dust, and glare of electric lights from Los Angeles in the future, with the city's increased growth, may prove a disadvantage, especially because of the comparatively short focus of the instrument. Several other sites are therefore being tested in comparison with Mount Wilson.

The trustees of the California Institute have placed the entire project in the hands of a committee of the Executive Council of the Institute, consisting of Dr. Hale; Dr. Robert A. Millikan, director of the Norman Bridge Laboratory of Physics; Dr. Arthur A. Noyes, director of the Gates Laboratory of Chemistry; and Mr. Henry M. Robinson, well known for his work as a member of the Dawes Commission and in other international undertakings. Dr. John A. Anderson, physicist and astronomer of the Mount Wilson Observatory, will serve as executive officer of the Observatory Council, in direct charge of design and construction. They will be assisted by an advisory committee including Dr. Walter S. Adams, director of the Mount Wilson Observatory; Dr. Frederick H. Seares, assistant director; Dr. A. A. Michelson, of the University of Chicago; Dr. Charles G. Abbot, secretary of the Smithsonian Institution; Prof. Henry Norris Russell, of Princeton University; and Profs. Richard C. Tolman and Paul S. Epstein, and

Ira S. Bowen, of the California Institute. Mr. George Eastman, and Dr. C. E. K. Mees, director of his research laboratory, have offered fullest co-operation in the study of special photographic problems. Dr. Ambrose Swasey, chairman of the Warner-Swasey Co.; Mr. Gano Dunn, president of the J. G. White Engineering Co., and recently chairman of the National Research Council; Dr. Frank E. Ross, of the Yerkes Observatory, and others equally well known, will aid in the work of design, and many other scientific workers especially qualified will be available for consultation.

Processes of Colour Photography.

By F. J. Tritton.

COLOUR photography is one of the few branches of photography that has made relatively little progress of recent years; in fact, for the last twenty years there has been nothing fundamentally new to record, if a recent invention to be referred to later be excepted.

There has, however, been a steady improvement in technique and a series of variants on known processes, which have made plainer the limitations and possibilities of this branch of photography. Also, for some reason which is difficult to define, there has grown up a distinct re-awakening of interest in colour photography, which is perhaps best exemplified by the recent formation of the Colour Group of the Royal Photographic Society. Considering its youthfulness, this group has had a highly successful first year and seems likely to develop steadily. Possibly the undoubted popular interest in colour cinematography has had something to do with this revival of interest in colour among the photographic community.

The foundations of colour photography were laid by Clerk Maxwell, Ducos du Hauron, Chas. Cros, and a few others between 1857 and 1870, but practical applications could not be very successful since colour sensitive plates were unknown. The first step in this direction was the discovery of the colour sensitising action of certain aniline dyes by H. W. Vogel in 1873. From this the panchromatic plate has gradually evolved, and one of the most remarkable achievements of recent photographic manufacture has been the improvement in quality, speed, and trustworthiness of these plates, culminating just recently in the introduction of the Ilford Soft Gradation Panchromatic Plate, which seems to have been intended primarily for the portrait photographer, but should prove of particular value to the colour photographer when its capabilities are properly explored.

The first successful colour photographs on paper were made by the carbon process by du Hauron, and, despite the advances made, this process is still one of the best. Commercial carbon 'tissues' for trichrome printing were first introduced about 1906 and the formulæ were scarcely altered or improved until quite recent years, when three-colour carbro began to assume greater importance than its parent process. The first step in this direction was the Manly ozobrome process, but the real advance came when, in 1914, Manners introduced his Raydex process, which is now unfortunately extinct, although the inventor is very successfully using his process to produce commercial colour prints in America at the present time.

Meantime, the Autotype Company had introduced three-colour carbro, the materials for which were improved in 1926. In this process three bromide prints are made from the three separation negatives, and from these three carbro prints are made in the respective printing colours on transparent celluloid temporary supports. In this way the action of light is cut out, except in the making of the bromide prints, and a much greater degree of control is introduced. This control is not required for purposes of 'faking' the colour rendering, and, in fact, must only be used in strict accordance with certain set principles or else accurate colour reproduction is impossible. But it is found that with the straightforward carbon process it is frequently difficult to obtain accurate colour intensities owing to the negatives being of the wrong 'gamma' to suit the printing medium employed. With the three contrast grades of bromide paper always available, and with the control over contrast provided by the carbro process, this difficulty disappears. A further great advantage is the ability to enlarge to any convenient degree without extra trouble. The making of enlarged copy negatives was always fraught with many dangers owing to the probability of varying the contrast range of one or more of the negatives.

Provided reasonable care is taken at every stage and all the usual precautions are observed, there is not the slightest difficulty in retaining accurate register of the three colours in greatly enlarged three-colour carbro prints, and undoubtedly this process is now the one most favoured. It is of interest to note that it is now being commercially used in America, France, and England for the production of 'originals' from which three-colour blocks are being made.

In the processes so far mentioned the colours used are insoluble pigments dispersed in the gelatin layer, and in modern commercial 'tissues' or pigment papers they can be considered as completely stable and fast to light, so that the finished picture is permanent.

The other important class of colour prints is based on the use of dyes. The first commercial process was Pinatype, introduced in England in 1905, and still occasionally used. In this process, three 'print plates' coated with dichromated gelatin are exposed behind positives, prepared from the separation negatives, so as to produce differential tanning. When the excess dichromate has been washed out, the print plates are dyed up in the appropriate Pinatype dye, rinsed and squeegeed into contact with a piece of damp gelatin-coated

paper. It is found that the untanned portions of the gelatin take up most dye and transfer it to the paper most readily, and, if the exposure has been correct, the tanned portions can be made not to transfer any dye. But in practice this is difficult to achieve, so that the high lights are nearly always stained and the process proved tedious. The dyes used are a special class only manufactured in Germany, the range appears to be limited, and they are not particularly correct as to colour. Compared to many dyes, their fastness to light is fairly good, but they cannot be described as permanent.

A later and much more satisfactory process is the Jos Pé, which again originates in Germany and uses the same dyes, only under a different name. The difference is that the print plate does not consist of an even layer differentially tanned but of a true relief image produced by washing away the soluble portion in hot water. This enables much cleaner and brighter prints to be produced, and some excellent work has been exhibited. In addition, the use of daylight printing is eliminated, since the print plates are gelatino-bromide plates exposed through the back and tanned by the use of a pyro developer deficient in sulphite. This has proved quite successful, but in my opinion pyro tanning is never able to produce the clean sharp image obtainable by chromium tanning.

Further improvements and simplifications along well-recognised lines in both the carbon and imbibition types of processes are very probable, but it is unlikely that they can ever solve the problem of colour photography and make it a process for the amateur.

Undoubtedly, the most important development in this branch of photography is the Martinez patent as improved by Colour Photographs, Ltd. The process is not yet quite ready for marketing, but extensive experimental work is being carried on and a number of demonstrations have been given and prints exhibited. In outline, the process consists in sensitising thin cellophane films in solutions which appear to be based on the use of light-sensitive iron salts. When dry these are exposed under the appropriate separation negatives to daylight or strong artificial light, when they print out very much like P.O.P., but the three types of film produce images which on fixing approximate very closely to the three primary colours. The fixing is a matter of extreme simplicity, water and dilute acid being used for the blue print, which belongs to the common prussian blue class, while hypo is used for the yellow print, and mercuric chloride fixes the red.

An extremely useful part of the invention is that it has been found possible to reduce the colour intensity of all three images; consequently, the correct colour balance can be obtained from any three partial colour images which are approximately accurate and slightly over printed, without having to make fresh prints. This has never been possible with any other process of colour photography; it has always been necessary to start again from the beginning if the print obtained was not accurate.

The three partial colour images are not transferred as in the carbon process, but the cellophane films are mounted one on top of the other, using a dilute gelatin solution as a cement.

The cellophane used has nearly all the properties which could be desired for such a process. Despite the fact that when wetted it stretches badly, it goes back to its original shape on drying and, most remarkable of all, it is truly elastic, so that if desired it can be stretched to obtain register. Also it will not scratch readily. If the three cellophane films were just cemented together on paper and dried they would curl very badly; this has been got over by the use of a thin sheet of celluloid as a support, the cellophanes being on both sides and so tending to curl in opposite directions.

Some of the prints by this process which have been exhibited are very fine and show accurate colour rendering, but artistically they are spoilt by the sheen on the surface, which is a necessity, since the image consists of sheets of polished cellophane. It is reported, however, that it will be possible to overcome even this. The prints obtainable are not likely to surpass in quality the best three-colour carbros, for example, but there is evidence that they will be distinctly easier to prepare and consequently should prove much more popular. Evidence as to the permanence of these prints over a period seems to be lacking.

There is another aspect of colour photography which is also being exploited by Colour Photographs, Ltd., namely, the production of a commercial 'tripack' which shall take all three negatives at once with any ordinary camera. The idea of the 'tripack' is by no means new, having been fully described in theory by Ducos du Hauron so long as forty years ago. Many inventors have tried their hand at the problems involved and several packs have been commercially marketed, but none has so far lived for long.

Perhaps the greatest difficulty is to obtain three different colour-sensitive emulsions which with unequal exposure but equal development will give negatives of the same contrast range or 'gamma.' Without this it becomes almost impossible to obtain accurate colour balance in both shadows and high lights. But with the resources of the modern emulsion maker, great improvements can no doubt be effected, so that many workers are eagerly awaiting the day when these packs are first marketed.

Some very good colour portraits taken in an ordinary camera with this pack have been exhibited, and it seems probable that the pack will prove most suited to this class of work rather than to outdoor photography, where the requirements as to sharpness and colour rendering are much more exacting.

In this 'tripack' three thin celluloid films are employed, the front one having a thinly coated blue sensitive emulsion and a dye which absorbs all the blue, the second a green sensitive coating and a dye which passes only the red rays, which fall on a special type of rapid red sensitive film. Theoretically this arrangement is quite simple and is the one which has been most frequently used, but it has the

(Continued on p. 701.)

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The Physics of the Universe.[1]

By Sir JAMES JEANS, Sec. R.S.

THE ancients were for the most part content to regard the universe as a theatre which had been specially constructed for the drama of human life. Men, and even the gods that man had created in his own image, came, lived, and disappeared after strutting their tiny hour upon a stage to which the eternal hills and the unchanging heavens formed a permanent background. While some thought was given to the birth of the universe, and its creation or emergence from chaos, very few thought of it as living its life and passing from birth to death in the same way as a man or a tree passes from birth to death.

In modern times the idea of secular change crept into the picture. Geologists began to study the earth as a changing structure, and astronomers to give thought to the evolution of the stars, recognising them as bodies which are born, live their lives of gradual change, and finally die. But the ultimate constituents of the universe, the atoms, were still supposed to be immune from change. The hypothesis that all matter consisted of permanent, indivisible, and unchangeable atoms, which had been advanced so far back as the fifth century B.C. by Leucippus and Democritus, remained practically unshaken until the end of the nineteenth century. The ageing of the universe was supposed to amount to nothing more than a re-arrangement of indestructible units which were themselves incapable of any sort of change or decay. Like a child's box of wooden bricks, the atoms made many buildings in turn.

ATOMIC CHANGES.

Then Crookes, Lenard, and, above all, Sir J. J. Thomson, began to break up the atom. The bricks of the universe which had been deemed unbreakable for more than 2000 years were suddenly shown to be very susceptible to having fragments chipped off; a milestone was reached in 1895, when Sir J. J. Thomson showed that these fragments were identical, no matter what type of atom they came from; they were of equal mass, and they carried equal negative charges of electricity, and so were called 'electrons.' Two years later, Lorentz's explanation of the newly discovered Zeeman effect provided evidence that the moving parts in atomic interiors were precisely similar electrons.

The series of researches so initiated were, after a few years, co-ordinated in the Rutherford view of atomic structure, which supposed the chemical properties and nature of the atom to reside in an excessively minute central nucleus carrying a positive charge of electricity, about which the negatively charged electrons described wide orbits. By clearing a space around the central nucleus, and so preventing other atoms from coming too near, these electronic orbits gave size to the atom. The volume of space kept clear by the electrons is enormously greater than the total volume of the electrons; roughly, the ratio of volumes is that of the battlefield to the bullets. The atom, with a radius of about 2×10^{-8} cm., has about 100,000 times the dimensions, and so about 10^{15} times the volume, of a single electron, of which the radius is about 2×10^{-13} cm. In all probability the 'nucleus' is even smaller than the electrons. The number of orbital electrons in an atom is called the 'atomic number' of the atom; it ranges from unity in hydrogen, the lightest and simplest of atoms, to 92 in uranium, which is the most massive and complex atom known.

Simultaneously with this, physical science was discovering that the nuclei themselves were neither permanent nor indestructible. In 1896, Becquerel had found that uranium salts had the remarkable property, as it then appeared, of spontaneously affecting photographic plates in their vicinity. This observation led to the discovery of a new property of matter, namely, radioactivity, and all the results obtained in the next few years were co-ordinated in the hypothesis of 'spontaneous disintegration' advanced by Rutherford and Soddy in 1903, according to which radioactivity indicates a spontaneous break-up of the atomic nuclei. So far from the atoms being permanent and indestructible, their very nuclei were now seen to crumble away with the mere lapse of time, so that what was

[1] The first Henry Herbert Wills Memorial Lecture of the University of Bristol, delivered at the University on Oct. 29.

once the nucleus of a uranium atom was transformed, after sufficient time, into the nucleus of a lead atom, and eight α-particles, which are the nuclei of helium atoms. Radiation is given off in the process, the radiation that affected Becquerel's photographic plates, and so led to the detection of the radioactive property of matter.

With the unimportant exceptions of potassium and rubidium, the property of radioactivity occurs only in the most complex and massive of atoms, being indeed limited to those of atomic numbers above 83. Yet, although the lighter atoms are not liable to spontaneous disintegration in the same way as the heavy radioactive atoms, the nuclei of these also are of composite structure, and can be broken up by artificial means. In 1920, Rutherford succeeded in breaking up the nuclei of atoms of oxygen and nitrogen by bombarding them with swiftly moving α-particles.

The success of this experiment led to the hypothesis, which has not yet been established beyond all possibility of doubt, that the whole universe is built up of only two kinds of ultimate bricks, namely, electrons and protons. Each proton carries a positive charge which is exactly equal in amount to the negative charge carried by an electron. The protons are supposed to be identical with the nucleus of the hydrogen atom; all other nuclei are supposed to consist of closely packed structures of protons and electrons.

In addition to containing material electrons and protons, the atom contains yet a third ingredient, namely, electromagnetic energy. Modern electromagnetic theory shows that all radiation carries mass about with it, one gram of mass being associated with 9×10^{20} ergs or $2\cdot15 \times 10^{13}$ calories of radiation. As a necessary consequence, any substance which is emitting radiation must also be losing mass; the spontaneous disintegration of any radioactive substance involves a spontaneous decrease of weight. The ultimate fate of a gram of uranium may be expressed by the equation:

$$1 \text{ gram uranium} = \begin{cases} 0\cdot8653 \text{ gm. lead.} \\ 0\cdot1345 \text{ gm. helium.} \\ 0\cdot0002 \text{ gm. radiation.} \end{cases}$$

Stated in a very general form, the phenomenon of radioactivity may be described as a transformation of material mass into radiation, or, to put it slightly differently, as the liberation of radiation by the destruction of material mass. Where 4000 gm. of matter originally existed, only 3999 gm. now remain, the remaining gram having gone off in the form of radiation.

Yet, the 3999 gm. of lead and helium contain precisely the same protons and electrons as the original 4000 gm. of uranium; we may then say that the 4000 gm. of uranium consisted of these electrons and protons together with 1 gm. of bottled-up electromagnetic energy which has since escaped in the form of radiation.

So far as terrestrial experience goes, this dissolution of mass into radiation is entirely a one-way process. Terrestrial rocks provide abundant evidence of uranium having continuously broken up into lead, helium, and radiation for the past thousand million years or more, but there is no evidence of the converse process ever having occurred. We must suppose that there is less uranium on earth to-day than there was yesterday, and that by to-morrow there will be still less. As a consequence, the earth each day radiates away a little more heat than it receives from the sun, and its mass continually diminishes. According to Jeffreys [2] the outward flow of radiation just inside the earth's surface is about $1\cdot9 \times 10^{-6}$ calorie per sq. cm. per second, all but about 13 per cent. of which arises from radioactive disintegration of the substance of the earth. We can calculate from this that radioactive disintegration causes the earth's mass to diminish at the rate of rather less than an ounce a minute; at this rate, terrestrial atoms are unbottling their energy and pouring it into space in the form of radiation. On earth at least the stream flows ever in the same direction; complex atoms giving place to simple, and mass changing into radiation. It is natural to ask whether a study of the physics of the universe reveals these processes as part only of a closed cycle, so that the wastage which we see in progress on earth is made good elsewhere. We stand on the banks of a river and watch its current ever carrying water out to sea, but we know that this water is in due course transformed into clouds and rain which replenish the river. Is the physical universe a similar cyclic system, or ought we rather to compare it to a stream which, having no source of replenishment, must cease flowing after it has spent itself? To answer these questions we must attempt first to trace our terrestrial stream back to its source.

The Origin of Terrestrial Radium and Uranium.

Radioactive atoms are of many kinds, but all have in common the property of spontaneous disintegration. The period of time required for this disintegration to occur varies enormously, some

[2] "The Earth," p. 88.

types of atoms having long lives of thousands of millions of years, while others have short lives of years, days, hours, or seconds, the most ephemeral of all being actinium-A, with an average life of only 0·002 sec. Let us take uranium and radium as being typical of the two classes.

Spontaneous disintegration reduces any store of radium to half in 1580 years, so that if a whole earth were built of pure radium only a single atom would be left after a quarter of a million years. Since the earth is many millions of years old, we may be confident that every atom of radium now on earth was born on earth. Soddy, Boltwood, and others have investigated the ancestry of radium. Its direct parent is found to be ionium, and it traces its descent back through uranium-X to uranium itself.

On the other hand, it takes 5000 million years for a store of uranium to diminish to half. As the earth was born out of the sun some 2000 million years ago, the greater part of any uranium it may have brought with it out of the sun would still be in existence. As we have no evidence of any uranium being born on earth, and as no parent substance is known out of which uranium could be born, it is reasonable to regard the earth's present store of uranium as the remains of a supply it originally brought out of the sun. An initial store of about 10^{19} gm. would suffice.

This uranium cannot have existed from all time, for the average life of a uranium atom is only about 7000 million years. How, then, did it come into being? Was it created in the sun, or did the sun, like the earth, start life with a supply which has continually diminished, and is destined ultimately to vanish entirely?

The answer to this question must of course depend on the age we assign to the sun, and an attempt to fix this takes us rather far afield.

The Ages of the Sun and Stars.

In a classical paper published in 1878, Clerk Maxwell studied the behaviour of a gas whose molecules were supposed to be massive points repelling one another with a force which varied inversely as the fifth power of the distance. There was no possibility of direct collision, since the molecules were supposed to be of infinitesimal size, but as each molecule threaded its way through its fellows, pairs occasionally approached so close as to influence one another's motion much as a direct collision would have done. At each such encounter a transfer of energy took place, the general tendency being towards equalising energies; the molecule with the greater energy of motion was ever being slowed down, and that with the lesser energy speeded up. If the molecules were of different weights, their continued encounters tended to bring about a state in which heavy and light molecules all moved with the same energy, the lighter molecules making up for the smallness of their mass by the rapidity of their motion.

It was no new discovery that the molecules of a gas tended to assume such a state. This had been known for some years, but Maxwell's investigation gave a means of calculating the time required to bring about this final state of 'equipartition of energy.' Maxwell calculated a time, which he called the 'time of relaxation,' such that all deviations from the final state of equipartition of energy were reduced to $1/e$ (37 per cent) of their original value in this time. For ordinary air it is found to be about $\frac{1}{6 \times 10^9}$ sec.

Maxwell's massive points, repelling according to the inverse fifth power of the distance, do not form a particularly good model of a gas, but on changing the law of force to an attraction varying as the inverse square of the distance (the law of gravitation), we obtain an absolutely realistic model of the stars, the diameters of the stars being so small in comparison with their mean distances apart that the possibility of direct collisions may be ignored entirely. Just as Maxwell calculated the 'time of relaxation' for his ideal gas, we can calculate it for a collection of massive points, having the masses and mean distances of the stars and attracting according to the law of gravitation. It proves to be of the order of millions of millions of years. After interacting on one another for a certain number, then, of millions of millions of years, the stars must attain to a final state of equipartition of energy, in which the average energy of all types of stars is the same, regardless of their mass.

So far back as 1911, Halm had suspected an approximation to equality in the energies of massive and light stars, and suggested that the velocities of the stars, like those of the molecules of a gas, might conform to the law of equipartition of energy. A more exhaustive investigation by Seares in 1922 showed the supposed approximation to be real. Table I. shows the average total velocity (C) obtained for stars of different types having different mean masses.

Everywhere, except in its first two lines, the table reveals a marked approximation to equality of energy of motion. The last ten lines show a range of 10 to 1 in mass, but the average deviation

of energy from the mean is only 9 per cent. This equality of energy can only be attributed to the gravitational interaction of the stars. For if it were produced by any physical agency, such as pressure of radiation, bombardment by molecules, atoms or high-speed electrons, this agency, as the last column of the table shows, would have to be in thermodynamical equilibrium with matter at a temperature of the order of 2×10^{62} degrees. Since no such temperatures are known in Nature, we must conclude that the observed equality of energy is the result of gravitational interactions extending over millions of millions of years. The stars must, then, have an age of this order of magnitude.

Other lines of astronomical investigation lead to the same conclusion; I will limit myself to one. A number of stars are 'binary,' consisting of two distinct masses which travel through space in double harness, describing closed orbits about one another because neither can escape from the gravitational hold of its companion. The single stars we have just discussed may appropriately be compared to monatomic molecules, but these binary stars must be compared to diatomic molecules. Energy can reside in their orbital motion as well as in their motion through space. Again we find that endless gravitational encounters must result in equipartition of energy, both from star to star and also between the different motions of which each binary system is capable. Further, when this final state is reached, the eccentricities of the elliptic orbits must be distributed over all values from $e=0$ to $e=1$ in such a way that all values of e^2 are equally probable.

TABLE I.—EQUIPARTITION OF ENERGY IN STELLAR MOTIONS.

Type of Star.	Mean Mass, M.	Mean Velocity, C.	Mean Energy, $\frac{1}{2} MC^2$.	Corresponding Temperature.
				Degrees.
Spectral type *B3*	$19{\cdot}8 \times 10^{33}$	$14{\cdot}8 \times 10^{5}$	$1{\cdot}95 \times 10^{46}$	$1{\cdot}0 \times 10^{62}$
,, *B8·5*	12·9	15·8	1·62	0·8
,, *A0*	12·1	24·5	3·63	1·8
,, *A2*	10·0	27·2	3·72	1·8
,, *A5*	8·0	29·9	3·55	1·7
,, *F0*	5·0	35·9	3·24	1·6
,, *F5*	3·1	47·9	3·55	1·7
,, *G0*	2·0	64·6	4·07	2·0
,, *G5*	1·5	77·6	4·57	2·2
,, *K0*	1·4	79·4	4·27	2·1
,, *K5*	1·2	74·1	3·39	1·7
,, *M0*	1·2	77·6	3·55	1·7

This final law of distribution of eccentricity of orbit is independent of the size of the orbit, but the 'time of relaxation' which measures the rate of approach to this final state is not. For the eccentricity of orbit is a differential effect, arising from the difference of the gravitational pulls of a passing star on the two components of the binary, and when these components are close together the passing star can get no grip on the orbit. For visual binaries, in which the components are usually hundreds of millions of miles apart, the 'time of relaxation' is again millions of millions of years, but it is a hundred times as great as this for the far more compact spectroscopic binaries.

The following table, compiled from material given by Aitken, shows the observed distribution of eccentricities:

TABLE II.—THE APPROACH TO EQUIPARTITION OF ENERGY IN BINARY ORBITS.

Eccentricity of Orbit.	Observed Number of Spectroscopic Binaries.	Observed Number of Visual Binaries.	Number in Final State.
0 to 0·2	78	7	6
0·2 ,, 0·4	18	18	18
0·4 ,, 0·6	16	28	30
0·6 ,, 0·8	6	11	42
0·8 ,, 1·0	1	4	54

As we should anticipate, the spectroscopic binaries show no approach to the final state; most of them retain the low eccentricity of orbit with which they start life. The visual binaries show a good approach up to an eccentricity of about 0·6, but not beyond. The deficiency of orbits of high eccentricity may mean that gravitational forces have not had sufficient time to produce the highest eccentricities of all, but part, and perhaps all, of the deficiency must be ascribed to the observational difficulty of detecting orbits of high eccentricity.

Clearly, however, the study both of orbital motions and of motions through space points to gravitational action extending over millions of millions of years. In each case there is an exception to 'prove the rule.' In the former case, it is provided by the spectroscopic binaries which are so compact that their constituents can defy the 'pulling-apart' action of gravitation; in the latter case it is provided by the *B*-type stars which are so massive, possibly also so young, that the gravitational forces from lesser stars have not greatly affected their motion.

This and other lines of evidence, when discussed in detail, agree in suggesting that the general age of

the stars is probably between five and ten million million years. It may even be possible to fix the age of the sun within the narrower limits of seven and eight million million years.

The Origin of Solar Uranium.

We now have all the data for discussing the origin of the radioactive atoms in the sun and stars. Thorium, the longest-lived of all radioactive substances, is reduced to half its original amount after 15,000 million years of spontaneous disintegration. A mass of pure thorium equal to the sun (2×10^{33} gm.) would be reduced to a single atom within three million million years. For uranium, with a half-value period of 5000 million years, the corresponding time is less than a million million years. When the earth was born the sun's age was greater than either of these times, so that the earth's portion of radioactive matter must have been generated during the sun's life in the sun itself.

The only possible escape from this conclusion would seem to lie in the supposition that the lives of atoms of uranium and thorium are in some way enormously prolonged by intense heat and fierce bombardment such as occur in the sun's interior. We cannot absolutely rule such a possibility out, but it is difficult to see any single consideration which could be adduced in its favour from the side either of experimental or of theoretical physics, and, in the present state of our knowledge, it would seem reasonable to disregard it.

Assuming that these atoms were born in the sun, the problem of the manner of their birth takes us to the very heart of present-day theoretical physics.

Let us consider, in some detail, two processes which occur on earth: the change of atomic make-up through a readjustment of electrons, and the change of nuclear make-up through spontaneous disintegration.

At first sight the two processes seem very dissimilar. The radioactive transformation of the nucleus is spontaneous, in the sense that nothing that we can do either expedites or hinders it. Each atom of uranium carries its own future history written inside it. It lives its appointed life serenely undisturbed by external accidents of heat or pressure; when its hour strikes it will cease to exist as uranium and will proceed to disintegrate into lead, helium, and radiation. Its nucleus slips back to a state of lower energy, the lost energy being put in evidence as emitted radiation. On the other hand, the change produced in ordinary atoms by electronic rearrangement is extremely susceptible to external physical conditions. Every spectroscopist knows how to chip off one, two, or even three electrons from the atom at will. Nevertheless, as was first made clear in a remarkable paper which Einstein published in 1917,[3] the difference is merely one of degree and not of kind.

The electrons in an atom are free to move from one orbit to another, and as the various possible orbits have different energies, the atom constitutes, to some extent, a reservoir of energy. For example, the hydrogen atom consists of a single proton as central nucleus, and a single electron revolving round it. According to Bohr's theory, the electron can revolve in orbits whose diameters (or major axes) are proportional to the squares of the natural numbers, 1, 4, 9, 16, 25. . . . The differences of energy between the various orbits are easily calculated; for example, the smallest two orbits differ in energy by 16×10^{-12} erg. If we add 16×10^{-12} erg of energy to an atom in which the electron is describing the smallest orbit of all, it crosses over to the next orbit, absorbing the 16×10^{-12} erg in the process and so becoming temporarily a reservoir of energy holding 16×10^{-12} erg. If the atom is disturbed, it may of course discharge the energy at any time, or it may absorb still more energy and so increase its store. But if it is left entirely undisturbed, the electron must, after a certain time, lapse back spontaneously to its original smaller orbit. If it were not so, Planck's well-established law of black-body radiation could not be true. In this process the atom ejects 16×10^{-12} erg of energy in the form of radiation and, as a consequence, experiences a diminution of mass to the extent of $1{\cdot}8 \times 10^{-32}$ gm. Thus a collection of hydrogen atoms in which the electrons describe orbits larger than the smallest possible is similar to a collection of uranium atoms in that the atoms spontaneously lapse back to their states of lower energy as a result merely of the passage of time, losing mass and emitting radiation in the process.

We have spoken of adding 16×10^{-12} erg of energy to a hydrogen atom in its state of lowest energy. We cannot of course do this simply by pouring miscellaneous energy on the atom, and expecting it to drink it up. The hydrogen atom only accepts energy which is offered it in the form of radiation of precisely the right wave-length; it treats all other radiation with complete indifference. Every atom is selective in the sense in which a penny-in-the-slot machine is selective; if we pour radiation of the wrong frequency on to an atom we may reproduce the comedy of the millionaire whose total wealth

[3] *Phys. Zeitsch.*, **18**, 122; 1917.

will not procure him a box of matches because he has not a loose penny, or we may reproduce the tragedy of the child who cannot obtain a slab of chocolate because its hoarded wealth consists of farthings and halfpence, but we shall not disturb the hydrogen atom.

This selective action of the atom on radiation is put in evidence in a variety of ways, but is perhaps most simply shown in the spectra of the stars. Light of all wave-lengths streams out from the hot interior of a star and bombards the atoms which form its atmosphere. These atoms drink up that radiation which is of precisely the right wave-length, but have no interaction of any kind with the rest, with the result that the radiation which is finally emitted from the star is deficient in just these particular wave-lengths. This is shown by the star showing an *absorption spectrum* of fine lines. As the atoms in the star's atmosphere absorb this radiation they move to orbits of higher energy, but in course of time they lapse back to their old orbits, and in doing so emit energy in the form of radiation of precisely these same wave-lengths. This does not, as might at first be thought, exactly neutralise the absorption of radiation, because the absorbed radiation was all travelling outwards, whereas the emitted radiation travels in all directions at random. Thus, if we view the atmosphere tangentially, as we can do with the sun's atmosphere at a total eclipse, we observe the same spectrum, no longer as an absorption but as an *emission spectrum* ; it no longer consists of dark, but of bright lines—the 'flash' spectrum.

Any atom, or indeed any other electrical structure, will select the radiation of suitable wave-length from all the radiation which falls on it, and use the energy of this radiation in rearranging its electron orbits. The amount of energy ϵ that the atom absorbs is connected with the wave-length λ of the radiation by the quantum relation $\epsilon\lambda = hC$, where h is Planck's constant ($6{\cdot}55 \times 10^{27}$ erg sec.), and C is the velocity of light. The quantity ϵ of energy given by this relation is called the 'quantum' of light of wave-length λ, and the wave-lengths of the radiation which any electrical structure selects are determined by the condition that the corresponding quantum of energy shall just suffice to shift its electrons from one orbit to another. Radiation will also be absorbed if its quantum provide sufficient energy to tear the electron out of the atom altogether, and set it travelling through space as a free electron. All radiation of which the wave-length is less than a certain critical limit fulfils this latter condition.

The more compact an electrical structure is, the greater the energy necessary to disturb it ; and the greater the quantum of energy ϵ, the shorter the wave-length of the corresponding radiation. It follows that a very compact structure can only be disturbed by radiation of very short wave-length.

As a rough working guide we may say that any structure will only be disturbed by radiation whose wave-length is less than 860 times the dimensions of the structure. The energy needed to separate two electric charges $+e$ and $-e$, at a distance r apart, is e^2/r, and, in general, the energy needed to rearrange or break up a structure of electrons and protons of linear dimensions r will be comparable with this. If λ is the wave-length of the requisite radiation, the energy made available by the absorption of this radiation is the quantum hC/λ. Combining this with the circumstance that the value of h is very approximately 860 e^2/C, we find that the requisite wave-length of radiation is about 860 times the dimensions of the structure to be broken up. In brief, the reason why blue light affects photographic plates, while red light does not, is that the wave-length of blue light is less, and that of red light is greater, than 860 times the diameter of the molecule of silver nitrate ; we must get below the '860-limit' before anything begins to happen.

The wave-length of the light emitted by an atom when it discharges its reservoir of energy is precisely the same as that of the light absorbed when it originally stored up this energy, for as the two quanta of energy are the same, the corresponding wave-lengths are the same. It follows that the light emitted by any electrical structure will have a wave-length of about 860 times the dimensions of the structure. For example, ordinary visible light has a wave-length equal to about 860 atomic diameters.

Atomic nuclei, like the atoms themselves, are structures of positive and negative electrical charges, and so ought to behave similarly with respect to the radiation falling upon them. The radiation which the atomic nuclei emit, and consequently also that which they are prepared to absorb, is, however, of far shorter wave-length than that emitted or absorbed by complete atoms. Ellis and others have found, for example, that the radiation which is emitted during the disintegration of radium-B has wave-lengths of 3·52, 4·20, 4·80, 5·13, and 23×10^{10} cm. These wave-lengths are only about a hundred-thousandth part of those of visible light. The reason is, of course, that the nucleus has only about a hundred-thousandth part the dimensions of the atom.

Since the wave-length of the radiation absorbed or emitted by an atom is inversely proportional to the quantum of energy, it follows that the quantum of energy needed to 'work' the atomic nucleus is about 100,000 times as great as that needed to 'work' the atom. If we compare the hydrogen atom to a penny-in-the-slot machine, nothing less than five-hundred-pound notes will work the radioactive nuclei.

Yet radiation of the wave-lengths just mentioned ought to be just as effective in rearranging the nucleus of radium-B as that of the longer wave-length is effective in rearranging the hydrogen atom. At least such radiation ought to precipitate the disintegration of radium-B. Whether it could ever be effective in forming radium-B out of radium-C and atoms of helium (or α- and β-particles) is a somewhat different question; possibly other conditions of which nothing is known must be fulfilled in addition to the presence of radiation of the appropriate wave-length.

Probably also the radioactive nuclei, like those of nitrogen and oxygen, could be broken up by a sufficiently intense bombardment, although the experimental evidence on this point is not very definite. If so, each bombarding particle would have to bring to the attack energy equal at least to that of one quantum of the radiation in question, and this requires it to move with an enormously high velocity.

In passing, we may notice that processes of the general type we have just been discussing form the hope of those modern alchemists who aspire to obtain gold by the transmutation of other metals. In its widest form, their ambition is to combine the electrons and protons of base metals with the third atomic ingredient, namely, electromagnetic energy, so as to form atoms of gold. Any success they may achieve will probably result in a gain of knowledge to abstract science rather than of wealth to themselves, since one of the ingredients they must necessarily use, namely, energy or radiation, is so expensive as to render the final product excessively costly. It would need at least an appreciable fraction of an ounce of energy to produce an ounce of gold, and with electric power at even a farthing per Board of Trade Unit, energy and radiation cost eleven million pounds per ounce. Whatever the gold standard may have to fear on the political side, it would appear to be thoroughly impregnable on the side of physics and chemistry.

Every wave-length of radiation has a definite temperature associated with it, namely, the temperature at which radiation of this particular wave-length is most abundant. We recognise this when we speak of a red-heat or a white-heat, and, although we do not do so, we might quite legitimately speak in the same way of an ultra-violet heat or an X-ray heat. The wave-length and the associated temperature are connected through the well-known relation:

$$\lambda T = 0{\cdot}2885 \text{ cm. degree.}$$

When this particular temperature begins to be approached, but not before, radiation of the wave-length in question becomes abundant; at temperatures well below this it is quite inappreciable.

We have seen that radiation of short wave-length is needed to break up an electric structure of small dimensions, and as we now see that short wave-lengths are associated with high temperatures, it appears that the smaller a structure is, the greater the heat needed to break it up. On combining the relation just given between T and λ with that implied in the rough law of the '860 limit,' it appears that a structure of dimensions r cm. will begin to be broken up by temperature-radiation when the temperature first approaches $1/3000r$. Atoms, for example, whose general dimensions are of the order of 10^{-8} cm., begin to be broken up when the temperature approaches 30,000 degrees; nuclei, whose general dimensions are of the order of 10^{-13} cm., must remain unaffected until the temperature approaches 3,000,000,000 degrees.

To take a more precise instance, yellow light of wave-length 6000A. is specially associated with the temperature 4800 degrees. At temperatures well below this there is no yellow light except such as is artificially created. Stars, and all other bodies, at a temperature of about 4800 degrees, are of a yellowish colour and show lines in the yellow region of their spectrum. These lines occur because yellow light removes the outermost electron from the atoms of calcium and similar elements. When a temperature of 4800 degrees begins to be approached, but not before, rearrangements of the electrons in the calcium atom begin to occur. This temperature is not approached on earth (except in the electric arc and other artificial conditions), so that terrestrial calcium atoms in general are at rest in their states of lowest energy. Einstein's paper of 1917 showed it to be a necessary deduction from Planck's law of black-body radiation that a collection of calcium atoms in other states would behave precisely like atoms of radioactive substances to the extent of spontaneously slipping back to states of lower energy.

Just as calcium atoms in the cool temperatures

of the earth simulate the behaviour of radioactive atoms, so radioactive nuclei, if raised to a sufficiently high temperature, would simulate the behaviour of calcium atoms in the hot atmosphere of a star. The shortest wave-length of radiation emitted in the transformation of uranium is about $0{\cdot}5 \times 10^{-10}$ cm., and this corresponds to a temperature of 5,800,000,000 degrees. When some such temperature begins to be approached, but not before, the constituents of the radioactive nuclei begin to rearrange themselves, just as the constituents of the calcium atom do when a temperature of 4800 degrees is approached.

We must probably suppose that rearrangements can also be effected by bombarding the electric structure with material particles. If so, the temperature at which bombardment by electrons, nuclei, or molecules would first begin to be effective is precisely the same as that at which radiation of the effective wave-length would first begin to be appreciable; the two processes begin at the same temperature.

We have seen, then, that the apparent difference between the behaviour of the calcium atom and of the uranium nucleus reduces, in theory, to a mere difference of temperature, although in practice the difference is all the difference between 5000 degrees and 5,000,000,000 degrees. The lower temperature is approached or exceeded in the atmospheres of most stars, so that the calcium atom is continually rearranging itself in these atmospheres, as is shown by the presence of the *H* and *K* lines of calcium in most stellar spectra. It is unlikely that the higher temperature is approached anywhere in the universe, although exceptions, arising from our ignorance rather than our knowledge, must possibly be made in favour of the centres of certain 'white-dwarf' stars and of the spiral nebulæ. Apart from these, no place is known hot enough to have any appreciable effect on the transformation, either by synthesis or by disintegration, of the radioactive elements, and we must conclude that they behave everywhere in the same spontaneous fatalistic way that they do on earth; nowhere is there sufficiently intense heat to cause them to vary their conduct.

Thus solar uranium, which, as we have already seen, must have been born in the sun, can scarcely have been born out of the synthesis of lighter elements, and so must have originated out of the disintegration of heavier elements. The position with respect to solar uranium is precisely analogous to that we have already reached in respect of terrestrial radium, but there is the outstanding difference that we know the ancestry of terrestrial radium, whereas we do not know that of solar uranium. But ancestry there must be, so that we are led directly to the conjecture that the sun must have contained, and presumably must still contain, atoms of atomic weight greater than that of uranium; astronomical evidence leads independently to the same conclusion. We are led to contemplate terrestrial uranium merely as the present generation of an ancestry that extends we know not how far back. The complete series of chemical elements contains elements of greater atomic weight than uranium, but all such have, to the best of our knowledge, vanished from the earth, as uranium also is destined to do in time.

TABLE III.—THE MECHANICAL EFFECTS OF RADIATION.

Wave-lengths (cm.).	Nature of Radiation.	Effect on Atom.	Temperature (Degrees abs.).	Where Found.
7500×10^{-8} to 3750×10^{-8}	Visible light.	Disturbs outermost electrons.	3,850° to 7,700°	Stellar atmospheres.
250×10^{-8} to 10^{-8}	X-rays.	Disturbs inner electrons.	115,000° to 29,000,000°	Stellar interiors.
5×10^{-9} to 10^{-9}	Soft γ-rays.	Strip off all or nearly all electrons.	58,000,000° to 290,000,000°	Central regions of dense stars.
4×10^{-10}	γ-rays of radium-*B*.	Disturbs nuclear arrangement.	720,000,000°	?
5×10^{-11}	Hardest γ-rays.		5,800,000,000°	
$4{\cdot}5 \times 10^{-12}$	?	Building of helium atom out of hydrogen.	64,000,000,000°	
2×10^{-12}	Highly-penetrating radiation.	Disintegrates nuclei.	150,000,000,000°	
$1{\cdot}3 \times 10^{-13}$	?	Annihilation or creation of proton and accompanying electron.	2,200,000,000,000°	

Table III. above shows the wave-lengths of the radiation necessary to effect various atomic transformations. The last two columns show the corresponding temperatures, and the places, so far

we know, where this temperature is to be found. places where the temperature is far below that entioned in the last column but one, the transrmation in question cannot be affected by heat, id so can only occur spontaneously. Thus it is itirely a one-way process. The available radiaon is not of the right wave-length to work the omic slot-machine, so that the atoms, absorbing energy from the surrounding radiation, are connually slipping back into states of lower energy, such exist; they continually transform their ass into radiation, while the converse transformaon of radiation into mass cannot occur.

For the sake of completeness, the table has been ktended so as to include certain other phenomena, ot so far discussed, to which we now turn.

THE ANNIHILATION OF MATTER.

Every square centimetre of the sun's surface ischarges radiation out into space at the rate of oout 1500 calories a second, from which we can ilculate that the sun's total mass is diminishing about 250,000,000 tons a minute. Whereas the ow of mass from the earth's surface, a total loss about an ounce a minute, is about equal to the ow of water from a dripping tap, the flow of mass om the sun's surface is about 150 times the flow water over Niagara. Many stars lose mass even ore rapidly; S. Doradus loses mass at the rate f about 45,000,000 Niagaras. The earth's loss of ass is readily explained in terms of radioactive isintegration, but this fails entirely to explain the ormously greater loss experienced by the sun. urthermore, the earth's loss of mass is probably placed many times over by falls of meteors and osmic dust, but no one has ever suspected or sugested any source of replenishment of the masses f the sun and stars which is at all comparable ith their known loss.

Thus the sun's loss of mass is cumulative and as in all probability gone on at its present, or at n even greater, rate throughout the whole of its ast age of some seven million million years. Ineed, astronomical evidence makes it fairly certain hat younger stars radiate more energetically than lder stars. When allowance is made for this, it is ound that the sun must have radiated many times present mass during its life of seven million nillion years; it must have been many times as massive at birth as it is now, and of every ton originally contained only a few hundredweight emain to-day. Since no form of radioactive disntegration with which we are acquainted results in such a diminution of mass as this, we are forced to suppose that something still more fundamental is responsible for the sun's diminution of mass and emission of radiation. Of each thousand atoms that the sun contained at its birth only a few dozen remain to-day, and we can only conclude that all the rest have been annihilated and their mass set free in the form of radiation. This transformation of atoms into radiation, although unknown to terrestrial physics, must clearly be one of the fundamental physical processes of the universe.

THE UNIVERSE AS A HEAT-ENGINE.

General thermodynamical theory shows that every natural system tends to move towards a final state of maximum entropy by steps such that, statistically speaking, the entropy increases with every step. In calculating this entropy, classical thermodynamics regarded the chemical atoms as indivisible, indestructible, and immutable; the system consisted merely of permanent atoms and energy, and maximum entropy was attained when this energy was partitioned between the kinetic and potential energies of the atoms and the energy of radiation travelling freely through space, in such a way that no possible redistribution could make the entropy greater.

Modern knowledge shows this scheme of thermodynamics to be totally inadequate. So far from atoms being the eternal unchangeable bricks of the universe, modern science finds them subject not only to constant change, but also to total destruction. Not only do their nuclei change their retinue of attendant electrons, but they themselves both crumble away into simpler nuclei, and dissolve entirely into radiation. Furthermore, energy can reside in other forms than those just enumerated; it can be used, stored, and transformed in changing electron orbits inside the atom, in breaking up atoms, in rearranging and breaking up the atomic nuclei and so transmuting the elements; it can be liberated by the complete annihilation of matter. Neither total energy nor total mass is any longer constant; the conservation both of mass and of energy has disappeared from physics, and only a kind of sum of the two is conserved.

THE END OF THE UNIVERSE.

The final state of the universe must be such that the entropy cannot be increased even by transmuting the elements or changing atoms into radiation. It could, of course, be calculated readily

enough if the necessary new and enlarged scheme of thermodynamics were available, but competing schemes are in the field. The Bose-Einstein scheme leads to one result, the Fermi-Dirac scheme to another; the results on both schemes have been worked out by Jordan.[4]

The two schemes lead to the same result in one particular limiting case, and this limiting case happens to give a wonderfully close approximation to the state of the universe as a whole. The limiting case is that in which space is almost empty of matter, a specification which sounds like nonsense until we find some common standard by which an amount of matter may be compared with an amount of space. If we measure an amount of matter by the amount of space it occupies, then the 'emptiness' of space is one of the commonplaces both of modern physics and of modern astronomy. It is not merely a question of the 'emptiness' of the atom, which has already been noticed. Hubble[5] has estimated that if all the matter within about 100 million light-years of the sun were uniformly spread out, it would have a mean density of the order of only about 10^{-31} gm. per cubic centimetre, so that even the very 'empty' atoms would be at several thousand million times their diameters apart.

We can express this emptiness of space in a more fundamental manner. The energy set free by the total annihilation of 1 gm. of matter is equal to C^2 or 9×10^{20} ergs, so that the total annihilation of all the matter of the universe, assuming an average density of 10^{31} gm. per cubic centimetre, would only provide an energy-density of 9×10^{11} ergs per cubic centimetre, which would raise the temperature of space from absolute zero to about 10 degrees abs. The emptiness of space is indicated by the lowness of this temperature in comparison with the temperatures, as shown in Table III., which are necessary to effect atomic and sub-atomic changes If we make the approximation of neglecting 10 degrees in comparison with the temperature of 2,200,000,000,000 degrees which corresponds to the annihilation or creation of electrons and protons, the various schemes of statistical mechanics give the same result for the number of electrons and protons left undissolved into radiation. Independently of the size of the universe, the dominating factor in this number is $e^{-mC^2/RT}$; and as the index of the exponential is the ratio of the two temperatures just considered, the number is entirely negligible. Thus the final state of maximum entropy is one in which every atom has dissolved away into radiation, or at least every atom which is capable of so doing. This conclusion must, I think, be admitted quite independently of any particular scheme of statistical mechanics. The approximation that space is empty may be stated in the alternative form that the extent of space is enormously great; space, regarded as a receptacle for radiant energy, is a bottomless pit. In the terminology of the older mechanics, space has so many degrees of freedom that there can be no thermodynamical equilibrium so long as any energy is concentrated in matter. In more modern language, there are so many phase-cells associated with detached radiation, that the chance of any energy being found elsewhere is negligible.

[4] *Zeitsch. f. Physik.*, 41, 711; 1927.
[5] *Astrophys. Jour.*, 64, 368; 1926.

The road by which the universe travels to this final state is disclosed by Table III. The last column is seen to contain entries only in its upper half; the temperatures necessary to effect the processes dealt with in lower half of the table are so high that, to the best of our knowledge, they are not to be found anywhere in the universe. When these latter processes occur, then, they are everywhere spontaneous; they are unaffected by the actual temperatures, and so absorb no radiation. Thus, the transformation, 'mass ⟶ radiation,' occurs everywhere, and the reverse transformation nowhere. There can be no creation of matter out of radiation, and no reconstruction of radioactive atoms which have once broken up. The fabric of the universe weathers, crumbles, and dissolves with age, and no restoration or reconstruction is possible. The second law of thermodynamics compels the material universe to move ever in the same direction along the same road, a road which ends only in death and annihilation.

The Beginning of the Universe.

The end of this road is more easily discerned than its beginning. The atoms which are now annihilating themselves to provide the light and heat of the stars clearly cannot have existed as atoms from all time; they must have begun to exist at some time not infinitely remote, and this leads us to contemplate a definite event, or series of events, or continuous process, of creation of matter. If we want a naturalistic interpretation of this creation, we may imagine radiant energy of any wave-length less than $1{\cdot}3 \times 10^{-13}$ cm. being poured into empty space; such radiation might conceivably crystallise into electrons and protons, and finally form atoms. If we want a concrete

picture, we may think of the finger of God agitating the ether. We may avoid this sort of crude imagery by insisting on space, time, and matter being treated together and inseparably as a single system, so that it becomes meaningless to speak of space and time as existing at all before matter existed. Such a view is consonant not only with ancient metaphysical theories, but also with the modern theory of relativity. The universe becomes a finite picture whose dimensions are a certain amount of space and a certain amount of time; the protons and electrons are the streaks of paint which define the picture against its space-time background. Travelling as far back in time as we can brings us not to the creation of the picture, but to its edge, and the origin of the picture lies as much outside e picture as the artist is outside his canvas. On is view, discussing the creation of the universe terms of time and space is like trying to discover e artist and the action of painting by going to e edge of the picture. This brings us very near those philosophical systems which regard the iverse as a thought in the mind of its Creator, d so reduce all discussion of material creation to tility.

Both these points of view are impregnable, but also is that of the plain man who, recognising at it is impossible for the human mind to comehend the full plan of the universe, decides that s own efforts shall stop this side of the creation of atter.

Atomic Transformations.

The transformation of uranium into lead and lium involves a drop of energy, but in the lighter ements the energy-change is in the reverse direcon. Four atoms of hydrogen are more, not less, assive than an atom of helium, so that their energyontent is greater. Thus helium can never disintegate spontaneously into hydrogen, although four oms of hydrogen might spontaneously unite to rm an atom of helium. They could not unite other spontaneously, except possibly as a rare cident, since the temperature of transformation, ,000,000,000 degrees, is higher than occurs in universe. Whether they ever unite even ntaneously remains an open question on which ions differ. Millikan at one time suggested process as the origin of the highly penetrating ation which bombards the earth from outer but recent observations rule this interation out; the observed wave-length of the ation is too short, so that the radiation must nate in something more fundamental even than the transformation of hydrogen into helium. Whether any such process can be found, short of the complete annihilation of matter, remains to be seen; personally, I feel doubtful.

Millikan has recently suggested that this radiation may result from electrons and protons falling together and forming atoms in regions outside the stars. As a collection of oppositely charged particles could not remain uncombined for long, he postulates a continual creation of protons and electrons out of the stray radiation of the stars; matter is continually being annihilated in the interior of the stars, and re-created outside them. This gives a cyclic universe which might go on for ever.

Like all other cyclic universes, however, it clashes with the second law of thermodynamics. A universe which is not in a state of maximum entropy moves irreversibly along the path of increasing entropy and so cannot be cyclic; one which is already in such a state must be macroscopically dead, and so cannot be cyclic in any sense perceptible to us. Indeed, it is easy to find the exact spot at which Millikan's concept comes into conflict with the second law of thermodynamics; it is that we cannot have protons and electrons transformed into radiation at a high temperature and then have the process reversed at a lower temperature.

Some may not regard this as a fatal objection to the scheme in question. All our discussion has been based on the supposition that the laws of physics remain valid at enormously high temperatures and under conditions entirely outside our experience. Consequently, all our conclusions can be avoided, and everything can be put back in the melting-pot, by the single hypothesis that the laws which govern matter out in space differ from those which govern matter on earth. Yet we have only found it necessary to assume the simplest and most fundamental of physical laws, namely, the second law of thermodynamics and the broad general principles of the quantum theory; and it is hard to imagine that such wide laws fail outside our laboratories. The obvious path of scientific progress would seem to lie in the direction of inquiring what consequences are involved in supposing these laws to be of universal scope, and then testing these consequences against the ascertained facts of observational astronomy. So far as present indications go, astronomy, so far from challenging these consequences, goes half-way out to meet them.

Apart from transitory rearrangements of atomic electrons, the fundamental changes in atoms consist

in transitions to states of lower energy. Under the classical electrodynamics, an electron describing a circular orbit of radius r about a charge E lost energy at a rate $\frac{2}{3}E^2a^2C/r^4$ (Larmor's formula), and this caused the radius r to decrease at a calculable rate; the charges inevitably and spontaneously fell towards one another. The quantum mechanics replaced this steady fall by a sequence of sudden drops, but according to Bohr's correspondence principle the rate of fall remains statistically the same, at any rate so long as the orbits are large, as on the classical electrodynamics; that is to say, the sum of the radii of the orbits of a whole crowd of atoms decreases through spontaneous jumps at just the same rate as though their motion was governed by the old mechanics. The spontaneous degradation of energy we have had under consideration is now seen to be the natural extension into quantum territory of that implied in Larmor's classical formula. Had it not been for this degradation of energy, the atoms would have been perpetual motion machines; Larmor's formula prohibited that. The quantum theory seemed at first to remove the prohibition and reconstitute the atom a perpetual motion machine. Then came Einstein's famous paper of 1917, which made it clear that even under the quantum theory perpetual motion was banned; spontaneous degradation of energy was shown to be implied in Planck's formula for black-body radiation. Once again, then, perpetual motion disappears from physics, and the grit in the bearings, which ultimately brings the machine to rest, is the natural quantum theory analogue of that which would have brought the machine to rest in the classical electrodynamics. Long ago we used to call it the interaction between matter and ether.

There appears to be one exception. The classical electrodynamics ruled out perpetual motion machines entirely. The new physics also rules them out, but permits the conspicuous exception of atoms in their state of lowest energy; these can go on in perpetual motion to all eternity, because there is no state of lower energy to which they can drop.

Is this exception real or is it only apparent? In a sense a state of still lower energy is reached when the electric charges, let us say of the hydrogen atom, fall into one another and the atom dissolves into radiation. We could remove the apparent exception from the new physics, and dismiss perpetual motion machines entirely from science, by supposing that after moving for a certain very long time in its state of lowest energy the hydrogen atom dissolved spontaneously into radiation. This might be dismissed as mere idle speculation were it not that the most fundamental physical process in the universe as a whole appears to be precisely this spontaneous dissolution of atoms into radiation.

If this kind of spontaneous dissolution should prove to be the true mechanism of the transformation of astronomical matter into radiation, then clearly bare nuclei and free electrons must be free from annihilation. Thus the conjecture may claim some support from the circumstance that the 'white dwarf' stars, in which the atoms are broken up completely, or almost completely, into their constituent nuclei and electrons, emit exceedingly little radiation; their substance would seem to be immune from annihilation. If the conjecture should ultimately prove its claim to acceptance, the main physical processes of the universe could all be included in one comprehensive generalisation, and the speck of radium which we watch in the spinthariscope would symbolise all the happenings of the physics of the universe.

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great disadvantage that the red sensitive film or blue 'printer' is at the back and must therefore of necessity lack definition, both on account of the thickness of the films and still more because of the scatter due to the silver grains of the two emulsions through which the red light has had to pass. This defect is quite noticeable in the negatives and still more in the prints, since it is the blue printer which mainly defines the contours of the subject. It is true, however, that this difficulty is nothing like so serious as it was in the earlier packs, because it is now possible to make relatively transparent emulsions which will retain their high speed, and also the rapidity of modern panchromatic emulsions make short exposures quite feasible.

The collection of colour prints on exhibition at the seventh International Congress of Photography

of skill has been attained by various workers, but, except among a very few, there is still a tendency to photograph objects because they have 'colour' rather than because of their artistic beauty, so that a collection of colour prints frequently has an appearance of crudity and brilliance which the exhibits taken individually do not justify.

This, however, is a stage which will be got over as colour photography becomes more popular, as there is every reason to believe that it will. With the increasing number of inventors now concentrating on its problems, and with the parallel advances in colour cinematography, it is evident that colour photography may confidently look forward to a brilliant future, and perhaps some day the inventor's dream may be realised of a grainless colour negative from which paper prints in full colour may be obtained by a single exposure.

On the Study of Popular Sayings.[1]

By Prof. Edward Westermarck.

WHEN I set out to gain some personal experience of native customs and beliefs and made lorocco my field of research, Sir James Frazer's 'The Golden Bough" directed my attention to uany facts that otherwise, in all probability, vould have escaped my notice. It offered sugestions and explanations, which were none the ss valuable because they were not always applicble to the particular data that came under my bservation; and it brought home to me the reat lesson, never to rest content with recording he mere external modes of native behaviour withut endeavouring, so far as possible, to find the leas or sentiments underlying them. For this eason I desire to render homage to my great eacher by stating some general results of my xperience as a field anthropologist.

It has been said to be a difficult or hopeless task try to discover why people perform rites and eremonies, that directly one approaches the underying meaning of rite or custom one meets only ith uncertainty and vagueness. This view is not onfirmed by my own observations in Morocco, here I generally found the natives to have quite efinite ideas about their rites. But the direct quiry into these ideas is not the only way in which ey may be ascertained. The most convincing formation is often obtained, not from what the atives say *about* their rites, but from what they y at the moment when they perform them. To ke a few instances. That the fire-ceremonies ractised in Morocco, as in Europe, on Midsummer y or on some other particular day of the year, purificatory in intention is obvious from the rds which people utter when they leap over them take their animals over the ashes. The Moorish thods of covenanting, which always imply some d of bodily contact, for example, by the parring of a common meal, derive their force from idea that both parties thereby expose themselves to each other's conditional curses; and the idea that food eaten in common embodies such a curse is very clearly expressed in the imprecation addressed to a faithless participant.

These customs, and the sayings connected with them, have led me to believe that the very similar methods—such as a sacrificial meal—used by the ancient Hebrews in their covenanting with the Deity were intended, not, as has been supposed, to establish communion, but to transfer conditional curses both to the men and their god. That one idea underlying the Moorish custom of tying rags or clothing to some object connected with a dead saint is to tie up the saint, and to keep him tied until he renders the assistance asked for, is directly proved by words said on such occasions. Some similar idea may perhaps be at the root of the Latin word for religion, *religio*, if, as has been conjectured, this word is related to the verb *religare*, to tie. It might have implied, not that man was tied by his god, but that the god was in the religious ritual tied by the man.

While a saying uttered on the occasion when a rite is performed is apt to throw light on the meaning of the rite, there are other sayings that can themselves be explained only by the circumstances in which they are used. This is the case with a large number of proverbs. It has been said that the chief ingredients which go to make a proverb are 'sense, shortness, and salt,' but the most essential characteristic of all is popularity, acceptance and adoption on the part of the people. Figurativeness is a frequent quality, but there are also many sayings recognised as proverbs that contain no figure of speech. On the other hand, there is scarcely a proverb that does not in its form, somehow or other, differ from ordinary speech. Rhythm, rhyme, and alliteration are particularly prominent features.

The proverbs of a people may be studied from different points of view. In many cases their study has been the pursuit of philologists, who have been mainly interested in the linguistic aspect of

[1] From an evening discourse, being a Fraser Lecture in Social hropology, 1928, delivered at the British Association meeting at sgow on Sept. 7.

the subject. But as a source of information on the language spoken by a people, its proverbs must be handled with caution, as they may contain expressions which are not found in the native idiom, but belong to another dialect from which the proverb has been imported, or, as is often the case with Arabic proverbs, have been taken from the literary language, which in many respects differs from the modern vernaculars.

Another method of studying proverbs is to examine their diffusion. Peoples have at all times been taking proverbs from each other. Among the nations of Europe we find a very large number of identical, or almost identical, proverbs which obviously have a common origin. Very many of our proverbs have been borrowed from the Romans, who themselves had borrowed many of theirs from the Greeks, and another great source has been the Bible. Others have come from the medieval monasteries, or been introduced into Europe by Jews or Arabs. The wanderings of proverbs are a fascinating study, but one beset with considerable difficulties. The resemblance between proverbs may have another cause than diffusion, namely, the uniformity of human nature, which makes men in similar situations think and feel alike. The real test of a common origin is not the mere similarity of ideas and sentiments expressed in the proverbs, but the similarity of former expression, of course with due allowance for modifications that are apt to occur when a saying is adopted from another language and transplanted into a new soil.

There is a third way of studying proverbs, which is primarily concerned with their contents as a subject of sociological or psychological interest. That in the proverbs of a people are found precious documents as regards its character and temperament, opinions and feelings, manners and customs, is generally recognised. Lord Bacon said that "the genius, wit, and spirit of a nation are discovered by their proverbs." There may be some exaggeration in statements of this kind, as many of the proverbs are not indigenous. But, on the other hand, a foreign proverb is scarcely adopted by a people unless it is in some measure congenial to its mind and mode of life; it may be modified so as to fit in with its new surroundings; when sufficiently deeply rooted it may in turn influence the native habits of thought and feeling; and if it does not succeed in being acclimatised in its adoptive country, it will wither and die.

Not infrequently some of the proverbs of a people contradict the teaching of others. Such incongruities may be more apparent than real. Proverbs may have the form of categorical imperatives on account of their necessary brevity, and in such cases their one-sidedness has to be corrected by others dealing with particular circumstances that modify the general rule. Moreover, as people are not all alike, one maxim may appeal to one person and another different maxim to another. There is, further, the distinction between proverbs that represent ideals and others that are based on realities which do not come up to these ideals. But it must not be assumed that a people's proverbs on a certain topic always tell us the whole truth about their feelings relating to it. The Moorish sayings concerning women and married life may serve as a warning. They are uniformly unfriendly or thoroughly prudential, and might easily make one believe that the men are utterly devoid of tender feelings towards their wives. But here we have to take into account their ideas of decency. It is considered indecent of a man to show any affection for his wife; in the eyes of the outside world he should treat her with the greatest indifference.

Proverbs are not merely reflections of life, but also play an active part in it; and this functional aspect of the matter should engage the attention of the student. Proverbs teach resignation in adversity, they give counsels and warnings, they are means of influencing the emotions, will, and behaviour of others, as they may influence one's own, whether they are shaped as direct commands, or are statements of some experience drawn from life, or are expressions of approval or admiration or of disapproval or contempt. The exceedingly frequent use of proverbs in Morocco, as in other countries with a Semitic culture, bears testimony to their great social adaptability. The proverb is a spice by which anybody may add piquancy to his speech; it shortens a discussion, it provides a neat argument which has the authority of custom and tradition, it is a dignified way of confessing an error or offering an apology, it makes a reproof less offensive by making it less personal. One reason for the great popularity that proverbs enjoy among the Moors is their desire to be polite; thus a proverb is often an excellent substitute for a direct refusal, which might seem inappropriate or rude. It also stops a quarrel and makes those who were cursing each other a moment before shake hands and smile; and it is used as a kind of *'ar*, implying a conditional curse, to compel a person who has suffered an insult to forgive the offender. Proverbs are thus conducive to goodwill and peace.

If proverbs are to be studied from the points of view I have advocated—without any desire to prejudice other methods of study—it is, of course, necessary to know their intrinsic meaning, and this imposes upon the collector a task which has seldom been satisfactorily accomplished. Many proverbs are no doubt perfectly intelligible without an explanation; others are only apparently so, because they easily suggest an interpretation which is not the correct one; and others cannot even deceive us, because they defy any attempt to unriddle their occult meaning. I cannot, therefore, strongly enough insist on the necessity of recording the situations in which proverbs are used, unless the collector has made sure that they have no other meaning but that which they directly express.

When we are sure of the intrinsic meaning of proverbs, and only then, we can find a reasonable solution of a problem that has proved a constant stumbling-block to collectors and compilers, namely, their classification. If proverbs are to be treated as a source of information for the sociological or psychological study of people, they cannot, as has usually been the case, be arranged simply in

alphabetical order by the first letters of the first word. They must be grouped according to the subjects or situations on which they have a bearing, and be accompanied with all explanations necessary for the right understanding of their import and implications. Proverbs that are applicable in different situations may have to be repeated under different headings; but to judge by my own experience, such repetitions need not be very many.

If due attention is bestowed upon the collection of proverbs, we may hope that the scientific study of them will keep pace better than hitherto with the progress made within other branches of folklore.

News and Views.

WHATEVER differences of opinion may exist with regard to Sir James Jeans's deductions concerning the origin and destiny of the physical universe, they have at least the cardinal virtue of making us think. His latest presentation of his views on these matters, which we publish as our supplement this week, is certainly no exception to the rule. The story he tells, with his customary skill in arranging his material and illustrating difficult points by telling analogies, leaves the reader sitting long in his chair, musing on old problems in the light of the new knowledge. In some respects the outlook has changed almost beyond recognition from that of our fathers and grandfathers; in other, and perhaps deeper, respects it remains very much as it has always been. The idea of a degradation of the physical universe by a series of sudden mutations appears to have taken the place of the old conception of a continuous process, and the change, from the point of view of the ordinary thinker, is by no means superficial one. Spontaneous changes, such as those f radio-activity, have an air of mystery about them. hy should one atom of uranium suddenly undergo metamorphosis while its apparently exactly similar eighbour remains unchanged for thousands of years? ifty years ago such a conception would have been garded as unscientific—a return to magic rather han a step forward. The quantum theory as a whole, fact, when considered in detail, contains an element f arbitrariness which would not have been permitted the older physics. It is only when we come to tatistical results that law and order once more esume their reign. There still seems to be no escape rom the second law of thermodynamics. If our view the process of degradation of the universe has hanged, the degradation itself still seems to be a fact, d in the place of an ultimate universe of dead, cold atter, we have an ultimate universe of dead, cold diation. The difference scarcely seems a matter of l concern.

DEGRADATION has an unpleasant sound, and it may that the picture that Sir James Jeans draws will to many a gloomy and forbidding one. It can rcely be repeated too often that any ideas now sible on such a subject as the fate of the universe be regarded as little more than the first glimpse vast ocean from a point on the shore. They seem plete and self-contained because, like the ocean, are necessarily bounded by a horizon, but the ine must not be mistaken for a real limit. The compactness of our view of the cosmic process erhaps itself a sign that we have not reached ity. It is not for science to 'believe because it is sible,' but in these matters we may well take the conjugate course of disbelieving because it is possible. But, at the same time, tentative attempts to survey the universe are not on that account to be dismissed as useless. After we have heard all that modern men of science have to say, we may have to come out by the same door that in we went, but we shall have heard great argument and come out wiser than before. Perhaps for the present we can learn no greater wisdom than that a degradation of the physical universe is not necessarily a degradation of the world of spirit. Sir James Jeans has already told us that it is only on the dead ashes of matter that life can begin to exist. Might it not be that only in the dead smoke of radiation can life attain its fullest development?

HEARTY congratulations are due to Dr. James W. L. Glaisher, F.R.S., mathematician, who on Monday next, Nov. 5, celebrates his eightieth birthday. Born at Lewisham, he was educated at St. Paul's School, afterwards proceeding to Trinity College, Cambridge, where he graduated second wrangler. A teacher of great distinction in mathematical science, embracing the whole of his working life, Dr. Glaisher has earned the esteem and gratitude of a host of academical pupils. Author of many original papers, most of the special mathematical journals in Great Britain owe editorship or guidance to his dutiful and long-continued labours. Dr. Glaisher has been twice president of the Royal Astronomical Society. In 1908 the London Mathematical Society awarded him the De Morgan medal, and in 1913 the Royal Society allotted him the Sylvester medal. He was president of Section A (Mathematical and Physical Science) at the Leeds meeting of the British Association in 1890. Dr. Glaisher's father, founder of the Meteorological Society, and pioneer in scientific ballooning, who himself, it may be recalled, passed the span of eighty years, is remembered in particular for his balloon ascent with Coxwell, the aeronaut, to a height of seven miles.

DR. CHARLES NICOLLE, director of the Pasteur Institute of Tunis, who has just been awarded the Nobel prize for medicine for 1928, in consideration of his work on typhus fever, is one of the most distinguished of living epidemiologists. His researches on typhus, which have been continued for more than twenty years, are of the utmost importance, as they have done so much to throw light on the causation of the disease and have greatly contributed to its effective prevention. Nicolle was the first to show that typhus fever could be transmitted from man to the chimpanzee, from which it could be passed on to the lower apes. Further investigations revealed that the

guinea-pig could also be successfully inoculated with the blood of a typhus patient, though the symptoms so produced were not so severe as in the experimental disease in the monkey, but merely consisted in a rise of temperature. The agent in transmitting the disease in man was shown by Nicolle to be the louse, especially *Pediculus vestimenti*, and to a less extent *Pediculus capitis*, while other parasites such as fleas, bugs, and mosquitoes had no such action. Lastly, Nicolle proved that the injection of the serum of convalescents from typhus fever conferred an immediate though transient immunity on those exposed to the disease. It may be noted in this connexion that in conjunction with E. Conseil, Nicolle was the first to show that the serum of measles convalescents possessed a similar protective value, and was thus the pioneer of a prophylactic method which has been widely used on the Continent. The value of the work of Nicolle and his assistants, which has been confirmed by all the other investigators of typhus, has been repeatedly illustrated in combating epidemics, particularly during the War, when the destruction of lice was found to be the most effective method of controlling the disease.

ON Oct. 25 the Bishop of Oxford unveiled a tablet in the Church of St. Peter-in-the-East, Oxford, to the memory of James Sadler, the "First English Aeronaut." Sadler was born in High Street, Oxford, in 1753 and died in George Street on Mar. 27, 1828. He was buried in the churchyard of St. Peter-in-the-East. The tablet has been erected by the Royal Aeronautical Society. Nothing is known of Sadler's early life except that, like his father, he was a confectioner. His first aerial voyage was made at dawn at Oxford, on Oct. 4, 1784, in a Montgolfier or hot-air balloon, and lasted about half an hour. The following year he made other ascents, but then turned his attention to chemistry, becoming assistant to the professor of chemistry at Oxford; from 1796 to about 1807 he was chemist to the Board of Naval Works at the Admiralty. He endeavoured to improve the steam engine and experimented on air-pumps, blasting, naval guns, and muskets. With the suppression of the Board of Naval Works, however, Sadler fell on hard times; but friends came to his assistance, and for a few years he again turned his attention to aeronautics and was well known for his ascents from Bristol, Cambridge, London, Brighton, Dublin, and other places.

AT the annual meeting of the Institution of Mining Engineers on Oct. 24, the president, Prof. H. Louis, presented the medal of the Institution to Sir Henry Hall "in recognition of his long and distinguished services in the advancement of the science and technology of mining." Sir Henry Hall was born at Sedgefield in the county of Durham, and served his time at the Haswell Colliery in the same county. He was appointed H.M. Inspector of Mines in the Swansea district in 1873, and in the following year was appointed Chief Inspector of Mines of the Liverpool district, to which the North Wales district was afterwards added, and he continued to hold this position until his retirement from the inspectorate in 1908. His work as an inspector was highly appreciated by all with whom he came in contact, his sound knowledge of all mining matters and conspicuous fairmindedness being universally appreciated. His main work was in connexion with the part that coal dust plays in colliery explosions. According to his own statement, his attention was first directed to this subject about 1874, and in 1890 he performed his famous experiments by which he demonstrated that coal dust, even in the absence of gas, could produce violent explosions. He gave evidence on this subject in the following year before the Commission appointed to investigate the matter, and in 1893 published his well-known report on "Coal Dust Explosions in Mines." Even after his retirement his advice and opinions were constantly resorted to on all mining matters, and it can fairly be said that there are few men who have rendered better service than has Sir Henry Hall to the coal-mining industry of Great Britain.

THE decision of the British Broadcasting Company not to undertake an experimental demonstration of radiovision by the Baird Company at present, has probably come as a surprise to many. Though it is difficult to judge when the art is sufficiently advanced to meet the public demand for entertainment, we should have thought that arrangements might have been made for the Baird Company to give a few experimental demonstrations from one of the B.B.C. stations which could be received by those of the public who are interested. The public would then be in a better position to judge whether broadcasting radiovision in Great Britain was desirable or not. In the United States the WGY station at Schenectady has been broadcasting a complete drama called 'The Queen's Messenger' by radiovision. It seems to have been rather crude. The actor's head and facial expressions were faithfully transmitted, but when it came to action, merely the actor's hands pouring out a glass of wine, giving a ring, or holding a revolver could be seen. Each actor had to work in front of a white screen, a background which gave definiteness to his features. He was constrained to act within a very limited area and his features were heavily 'made up.' Those of the audience who knew the difficulties in the way were appreciative. Unfortunately, the optimistic accounts which have appeared in the press will lead to the disappointment of many who see the radio pictures for the first time. We see no reason, however, why preliminary experiments should not be permitted.

AT Edinburgh, on Oct. 25, the Secretary of State for Air discoursed to the Royal Geographical Society of Scotland on the dramatic way in which a novel and untried auxiliary arm has achieved the status of the Third Fighting Service. We are warned that the problem of air defence demands increasing expenditure. In some mitigation, the policing of uncivilised frontiers is found less costly with judicious use of the air arm, and fascinating glimpses were given of the effect of a flying display on the primitive mind. The application of air transport in unsettled territories is full of promise, but critical comment might be made

on the claim that civil aviation offers any serious competition to established railways and shipping lines, and the idea of mass migration by air within the British Empire has a somewhat airy basis. Civil aviation must be regarded at present mainly as a reserve, almost immediately available in emergency, to which the recent development of light aeroplane clubs promises an appreciable contribution. Expenditure in this direction may well produce better returns than further direct military expenditure, at least up to an appreciable proportion.

IN the somewhat optimistic references to airships in Sir Samuel Hoare's address, there is a welcome note of caution on the experimental nature of R100 and R101. The argument that we must build because others were building lost its force when the *Shenandoah* accident restricted American activities drastically. The argument is now used on the other side, that because British airships are being built, therefore the U.S.A. must do so too. The latest German airship is much smaller and less costly than the new British airships. The suggestion that it also is "as we believe, far inferior in design and construction to our own," seems less than probable, and it is a pity that the technical advisers should inspire such premature awards to their own ability. Apart from the question of airships, which is likely to remain contentious for some time to come, the speech commands confidence as a fair and balanced summing up of our air position in its vital relation to the security of Great Britain.

STUDENTS of living creatures will find much of interest in the series of animal paintings by Mr. C. E. Swan, on view in the Art Gallery at 14 Brook Street, New Bond Street, W.1. The paintings, fifty-two in number, are in the main studies of mammals, and especially of the larger carnivora. Lovers of the London 'Zoo' will here discover the portraits of some of their old favourites. Mr. Swan knows his animals, and he is particularly happy in rendering their expressions, as may be seen (to mention but three examples) in "Marcus" (No. 45, the well-known orang which lived some time ago in the 'Zoo'); in "Bos Caffer" (the African buffalo, No. 5); and in "Wandered from the Lair" (the two lion cubs looking at a snake, No. 26). The different characters of these two cubs may readily be perceived and understood by anybody who has ever made an intensive study of the various characters of a family of young carnivores. The paintings will remain on exhibition until Nov. 6.

THE lecture on "Science in Western Civilisation," which Mr. J. B. S. Haldane delivered to the Fabian Society on Oct. 25, was a reasoned plea for science in government, or, more correctly, the 'scientific viewpoint' in national affairs. Mr. Haldane would be satisfied if the Cabinet contained one member with a knowledge of science equal to a second class in the Cambridge Natural Science Tripos, Part I. Motor taxation, he suggested, must have been devised by a lunatic. Commenting on science in journalism, the lecturer said that the *Times* announced the production of the compound of helium and mercury as an important item of news, when full particulars had been published in NATURE some weeks before. On eugenic questions, he drew opposite conclusions from Dean Inge and Major Darwin. If the wish to leave adequate fortunes restricted the size of families, why not abolish hereditary wealth? Forecasting the future, some of those present might expect to see synthetic foods and drugs, such as cocaine and morphine. Russia was trying to inculcate a scientific outlook and habit of thought, and was doing valuable research work, especially in genetics; but he refused to predict whether its form of national organisation would survive economic tests. Appropriately for a Labour gathering, he insisted that the scientific man is usually a manual worker. The lecture was followed by a large audience with sustained interest and, at its conclusion, elicited questions, in reply to one of which Mr. Bernard Shaw was assured that he (Mr. Shaw) was not a scientific man.

RECENT additions to the British Museum (Natural History) include the following:—In the Department of Zoology, a specimen of the Congo race of Lord Derby's Eland (*Taurotragus derbianus congolanus*), one of the most important accessions of recent years, has been received from Sir Charles Markham, Bart. The Congo race is very closely allied to the typical Derby Eland, from West Africa. The eastern race from the Lado Enclave (*Taurotragus derbianus gigas*) is frequently referred to as the Giant Eland; in general proportions, however, the Lado animal does not markedly exceed either the typical Derby Eland or the Congo form. To the collection of birds have been added seven examples of the Altai Snow Cock (*Tetrœgallus altaicus*), a large grey bird about the size of a hen Capercaillie, and grey all over with the exception of the breast, which is white. These birds were purchased in Smithfield Market, a large number having been imported in cold storage from the Altai Mountains in Central Asia, where the bird is not uncommon at altitudes over 7000 ft. above sea-level. Other species are found in the different mountain ranges of Northern Asia. The Geological Department of the Museum has received a collection of more than 400 specimens of London Clay fossils, collected bed by bed at Bognor, Sussex, by the donor, Mr. E. M. Venables.

AN interesting addition to the Mineral Collection in the British Museum (Natural History) is a large block (139 lb.) of willemite ore from Franklin Furnace, New Jersey, specially presented by the New Jersey Zinc Company for demonstrating the fluorescence of minerals in ultra-violet rays. The pale-green willemite (zinc silicate) is intermixed with snow-white calcite, pink rhodonite, and black crystals of franklinite. Under the influence of the ultra-violet rays, the willemite shines up with a brilliant green and the calcite with a rose-red glow, producing a very striking effect. Another valuable present is a large isolated and doubly terminated crystal of quartz (rock-crystal) weighing 34 lb. recently collected on the Piz Nor, Tavetsch valley, Switzerland, presented by Mr. F. N. Ashcroft. The Department of Botany has purchased 652 specimens of Indo-Chinese plants from the classic locality in which

Joannes de Loureiro made in the eighteenth century the collection (now in the Department of Botany) on which his "Flora Cochinchinensis" (1790) was based.

THE Director of the Meteorological Office is investigating the violent 'whirlwind' which struck the West End of London on Monday evening, Oct. 22, and has asked for the loan of the records of recording barometers or any other recording meteorological instruments from anywhere within a radius of about 20 miles of Charing Cross. Up to Oct. 26, he had received 92 communications, of which 74 were accompanied by barograms, and many contained other valuable information. From the records received it appears that the disturbance moved northwards along a straight track of small width, from near Victoria Station to Euston, passing near Piccadilly Circus and Oxford Circus. It then continued in the same line with diminished intensity. Barograms on the track differ from those off it in showing an additional very sudden fall and recovery of the barometer as the disturbance passed. They tend to confirm that the phenomenon had many of the characteristics of an American tornado. Disturbances of a similar kind occurred in other parts of England on the same occasion, in particular at Bromley, Kent, and near Hythe, Southampton. Records should be addressed to the Director, Meteorological Office (M.O. 12), Air Ministry, Kingsway, W.C.2.

PROF. RAYMOND A. DART, professor of anatomy in the University of the Witwatersrand, Johannesburg, has been elected a corresponding member of the Italian Institute of Human Palæontology, Florence, "in recognition of their deep appreciation of the distinction he has achieved in their branch of science." The membership of the Institute is restricted to 50 Italians and 50 corresponding members.

PROF. W. E. DALBY will give an address to the London Local Section of the Institute of Metals, on Nov. 8, at 8 P.M., at the Royal School of Mines, South Kensington, S.W.7, on "The Plastic Contour." Prof. Dalby will deal with his own work on the mechanical properties of materials. The meeting is an open one, for which tickets can be obtained on application to the Hon. Secretary, Mr. W. T. Griffiths, c/o The Mond Nickel Co., Ltd., Victoria Station House, London, S.W.1.

THE reform of the British patent system is the subject of a report which is to be issued by the British Science Guild next week. Eighteen months ago the Guild appointed a committee to study the problems which arise in this connexion, under the chairmanship of Dr. W. H. Eccles. The members of the committee included well-known inventors, research workers, barristers, patent agents, and ex-officers of the Patent Office, and it is understood that they will put forward about fifty proposals of a practical character for the general improvement of the system and the remedy of existing anomalies and hardships. It is now twenty years or more since the last extensive amendment of the patent laws in Great Britain took place, and the time is undoubtedly ripe for a thorough overhauling, in the light of the experience gained during that period, of this vital factor in industry.

MR. CECIL L. HORTON, of the Department of Lands, Jerusalem, writes to point out that the equation between the month of August and the Moslem month of Muharram in our Calendar of Customs and Festivals (see NATURE, Sept. 1, p. 334) is incorrect. The Moslem year being divided into lunar months, there is no fixed correspondence between the Islamic and Roman calendars. He adds that in the current year the 1st Muharram occurred on June 18, and next year will fall about June 7. Mr. C. A. Silberrad, of Forest Side, Epping, also writes to point out that in our note on his correction in reference to the Moslem year (see NATURE, Sept. 29, p. 489) it should have been made clear that the maximum variation of twenty-two days was in respect of the Hindu solar-lunar year only, whereas the Moslem calendar works back eleven days in each Christian year, and a whole year in thirty-three Christian years. In the course of this cycle of thirty-three years any Moslem festival occurs approximately thrice in every month of the Christian year.

MESSRS. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, have just published Catalogue No. 420 of second-hand books on botany, agriculture, early medicine and surgery, forestry, fruit-culture, gardens and gardening, herbals, modern medicine, and tobacco. Of the 1800 works listed, many are exceedingly rare. The catalogue should be of great interest and value to librarians and others.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A research assistant and demonstrator in geology in the University of Leeds—The Registrar, The University, Leeds (Nov. 5). A graduate assistant to teach physics and electro-technology at the Junior Technical School and the Technical College, Barrow-in-Furness—The Director of Education, Town Hall, Barrow-in-Furness (Nov. 7). A professor of economics in the University of Adelaide—The Agent-General for South Australia, Australia House, Strand, W.C.2 (Nov. 20). A professor of mathematics in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, W.C.2 (Dec. 18). A lecturer in economics and public administration in the Department of Adult Education of University College, Nottingham—The Registrar, University College, Nottingham. A Drapers' Company research scholar in dyeing at the Huddersfield Technical College—The Principal, Technical College, Huddersfield. A junior assistant under the Directorate of Explosives Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

ERRATUM.—The first sentence in the third paragraph of the letter by Messrs. Aborn and Davidson, entitled "X-Ray Studies of the Structure of Salts Adsorbed on Cellulose," in NATURE of Sept. 22 (p. 440), should read: "Investigations were made both with starch and with cellulose in the form of filter paper."

Research Items.

ROCK-PAINTINGS IN THE LIBYAN DESERT.—In *Antiquity* for September, Mr. D. Newbold describes a number of rock-paintings not previously seen by Europeans from various localities in the Libyan Desert. These were visited in the course of two expeditions in 1923 and 1927. Stone implements and pottery were also collected. The object of the expeditions was to examine archæological evidence with the view of the elucidation of the ethnological history of the area, to which there are references going back so far as the eighteenth dynasty in the Egyptian monuments. The rock pictures are here classified into four groups: (*a*) Bushman—late palæolithic or early neolithic; (*b*) Early Libyan—early neolithic, predynastic, and Old Empire; (*c*) Middle Libyan—Middle and Late Empire down to the introduction of the camel into the Sudan, that is, the early Meroitic period; and (*d*) Roman, medieval and modern. For (*b*) and (*c*) there are references to Libyans in the Egyptian monuments; for the latter half of (*c*) the evidence of Greek and Roman geographers and a few vague references in native 'Histories'; and for (*d*) the same authorities and Arabian geographers. In the areas visited, of which the pictures are here described, Owenat shows examples ranging from the earliest to the third period, Nukheila, Zolat el Hammad, and Um Tasawir examples from the second and third, while those at Qalaat el Wish and Abu Sofian are of the last modern period. The Kordofan pictures are difficult to date.

AN EARLY DRAWING OF A FLORIDA CHIEF.—In Volume 81, No. 4, of the *Smithsonian Miscellaneous Collections* is reproduced for the first time a drawing of an Indian 'King,' Saturioua, a Timucua chief in Florida in 1564. The drawing was executed by Jacques Lemoyne de Morgues, who accompanied Laudonnière to America in the reign of Charles IX. of France. Lemoyne was attached to the expedition as artist to map the coast and sketch the natives and their dwellings. Apparently his are the first drawings of Indians known to have been brought to Europe. They were reproduced by De Bry, who also published the artist's notes, purchased from his widow, in 1891. Among the published drawings is one of Saturioua in the act of performing a ceremony before he set out on an expedition against his enemies. The ceremony, of which two accounts are extant, consisted in part in scattering water towards his followers who sat round him in a circle, and then pouring the water on the embers of a fire so that his enemies might be quenched in like manner. The newly published drawing shows the chief at the moment when he has completed the ceremony with the bowl still in his hand. Lemoyne afterwards settled in England, possibly on account of being a Huguenot, and lived with Sir Walter Raleigh. It is possibly due to his influence that Raleigh's expedition to Virginia in 1585 carried an artist, whose instructions were very similar to those given to Lemoyne twenty years before.

RESULTS OF OPERATIONS FOR CANCER OF THE BREAST.—The Ministry of Health has recently issued another report on cancer, dealing with the late results of operation for cancer of the breast, based upon an analysis by Dr. Janet Lane-Claypon of 2006 cases occurring in the practice of general hospitals in eight county boroughs (*Reps. on Pub. Health and Med. Subjects*, No. 51). Arrangements were made for ascertaining the fate of all patients submitted to operation for breast cancer, assessed over periods of 3, 5, and 10 years after operation. The of growth has apparently little influence on the success or otherwise of operation. Early operation before the growth has spread beyond the confines of the breast is most important. When treated at this stage the percentage of survivals to 10 years is 73; when the disease has spread, the corresponding percentage falls to 13. Unfortunately, not more than 25 per cent of the hospital patients operated on are at this early stage. The nature of the operation performed is also very important, and the radical operation involving complete removal of the breast and underlying tissue with clearance of the axilla is generally to be preferred. Contrary to common belief, the prognosis was not worse in younger persons. The main lesson of this report is that a 'lump' in the breast of an adult woman calls for diagnosis and treatment without avoidable delay. If the lump be not cancerous, the anxieties of the patient are relieved; if it is cancerous, delay spells disaster, whereas treated by early operation the prospects are excellent.

BIOLOGICAL STABILITY OF THE ARISTOCRACY.—An investigation of the information contained in *Burke's Peerage* leads F. A. Woods to the conclusion that wealth and power do not lead, as is so often asserted, to idleness, sterility, and degeneracy. On the contrary, there are good reasons for considering aristocracy to be in many ways superior to the masses of mankind. Of 622 British peers in *Burke's Peerage* (1921), 334 are continuously aristocratic in the direct male line of their family trees to as early as the year 1450. Old families, then, do not become decrepit because of their old age, but in a general way families that once acquire high social position retain the high level. The author analyses the causes which contribute to this biological stability: ambition, capacity for advancement, family pride, marriage in the same social stratum, desire to leave heirs, and so on, any or all of which may be ingredients in the biological inheritance of the families concerned (*Jour. Heredity*, September 1928).

FERTILE MARE MULES.—A. H. Groth describes a very unusual case of fertility in a mule in the September issue of the *Journal of Heredity*. In 1920 a female mule, then twenty years of age, was reported to have given birth to a live female offspring sired by a jack. The two animals were acquired for observation by the Agriculture College of Texas. The colt developed into a dark bay mule showing no more characters of sire than an ordinary mule. The parent, "Old Beck," was mated unsuccessfully to a jack in 1921, but successfully to a bay saddle stallion in 1922, the result being a bay stallion colt in almost every respect like his sire. This animal has developed into a nicely balanced horse of saddle type, of remarkable intelligence, but showing a mule characteristic in his dislike to cross streams and ditches. He has been mated with several mares, one of which produced a bay stud foal. The original mare mule has, since the birth of her second foal, been mated on several occasions with jacks, but has had no further progeny, nor has success attended the mating of the older colt with stallions, jacks, or her half-brother. A second communication in the same journal records the birth of a "sure-enough" foal of a mare mule, sired by a jack, in Nebraska. The mare has been bred back to the same jack, and is believed to be again in foal.

THE DISTRIBUTION OF BRITISH SHEEP.—An analysis of the present-day distribution of breeds of sheep in the British Isles has led J. E. Nichols to some interesting conclusions regarding the climatic conditions best

fitted for each breed (*Jour. Textile Institute*, September 1928). It is assumed that in the case of sheep, as amongst wild animals, the distribution of each race or species is related to an optimum series of environmental conditions, so that there has come to be an association of definite types with definite environments, and the success of sheep-breeding involves the cultivation of the suitable type for particular local conditions. These conditions can be defined for British breeds of sheep. By considering together temperature and rainfall, it may be considered that the most suitable climatic environment for the Down breeds is a monthly rainfall of 2 inches or less from about February to June, with a mean temperature of not less than 37° F. for January and February; for the lowland long wools, the rainfall may rise to about 2¼ inches with the same temperature conditions; while for the mountain and moorland types, the most suitable months for lambing are those during which the figures for rainfall and temperature most closely approach 3 inches and 40° F. respectively. It can also be said that generally the breeds which are most widely distributed in altitude are those which can withstand the greater number of rainy days.

SHALLOW-WATER ANTHOZOA OF HAWAII.—The late Prof. A. E. Verrill (1839–1926), of Yale, spent the last two years of his life in Hawaii and devoted much of his time to collecting on the reefs. His incomplete paper on the Hawaiian Anthozoa has been prepared for publication as *Bulletin 49* (1928) of the Bernice P. Bishop Museum, Honolulu, by Prof. C. H. Edmondson. Gorgonians and Alcyonacea appear to be almost lacking in shallow water and on the coral reefs of Hawaii, although both groups are abundantly represented around the Polynesian islands. A thin, encrusting, soft Alcyonacean, referred to a new genus *Sarcothelia*, and species of *Allogorgia* and *Euplexaura* of probable Hawaiian origin are described. Thirteen new species of Actiniaria, three new Zoanthids, and two new Antipathes are also described. One of the Actiniaria is *Sagartia pugnax*, which is carried about as a commensal in the chelæ of two species of small crabs—*Lybia* (*Melia*) *tesselata* and *Polydectus cupulifera*. Prof. Edmondson confirms Dr. Borradaile's statement that when the actinians are removed the crab immediately picks them up again, and he also states that when *Tealopsis nigrescens* (actinians of very different colour and appearance) were provided, the crab seized them and carried them about even when they were much too large. Prof. Verrill was apparently not aware that the anemone which he described as *Sagartia pugnax* had been referred by Prof. Duerden in 1903 to the genus *Bunodeopsis*.

MIOCENE MOLLUSCA FROM FLORIDA.—The monograph on "The Molluscan Fauna of the Alum Bluff Group of Florida," by Julia Gardiner, to which attention has already been directed (NATURE, Jan. 22, 1927), has now been completed by the publication of a fifth part (*U.S. Geol. Surv.; Professional Paper*, 142 E). This contains the account of the Tellinacea, Solenacea, Mactracea, Myacea, and one Brachiopod (*Discinisca aldrichi*, n. sp.). The Alum Bluff group exhibited conditions of unstable temperature and marked an epoch exceptionally favourable to the recording of environmental changes in a shifting and developing molluscan fauna.

SOUTH AFRICAN CHITONS AND CHITON PHYLOGENY.—A series of South African chitons collected by Lieut.-Col. Turton have now been described by Mr. E. Ashby, who appends a list of the known forms from that region (*Proc. Malac. Soc. Lond.*, vol. 18). Holding that the discovery of the fossil form *Protochiton* has largely removed difficulties that faced systematists when dealing with the classification of the group, the author considers that the phyla Acanthochitonidæ and Lepidopleuridæ were developed along parallel lines from the palæozoic stock in which the insertion plate is absent, and that it is therefore desirable that the Lepidopleuridæ should not be included under the suborder Eoplacophora but should form the most primitive family under the suborder Chitonina.

MUTANTS OF *ŒNOTHERA LAMARCKIANA*.—Around this plant, a classic in the study of mutation, a vast literature has arisen which may somewhat obscure the salient facts from all but the specialist student. Probably all students of genetics will therefore find useful a brief analysis of the different types of mutants in this plant, which is published by Hugo de Vries and R. R. Gates in the *Zeitschr. für induktive Abstammungs- und Vererbungslehre*, 47, 275-286, 1928. The account is illustrated by photographs of some of the main types, taken by Prof. Gates in the experimental garden at Lutteren. Seven primary mutants are described; all are trisomic, that is, they have the normal 14 chromosomes, 7 from each gamete, and then in each case they have one extra, but it is assumed that in each case it is a different one of the seven chromosomes that is thus doubled, and that this fact is closely connected with the different characters of the mutant. Three other trisomic mutants arising from *Œ. Lamarckiana* are known as accessory mutants because they arise more frequently (up to 9 per cent of the progeny) from certain primary mutants; on the other hand, these accessory mutants never give rise to the primary mutants. Then there are the well-known polyploid mutants, with multiple sets (21 or 28) of chromosomes. One of these, *semi-gigas*, gives rise to a number of secondary mutants. Whilst in the primary mutants the pollen is normal and the extra chromosome is carried only in a proportion of the ovules, in certain homozygotic mutants both pollen and ovules carry the same hereditary characters. Thus from unstable half-mutants of this type, by ordinary Mendelian segregation, 25 per cent of stable isogamic mutants are obtained and 25 per cent of empty seeds.

DISEASES OF THE RASPBERRY.—*Special Bulletin*, Number 178 of the Agricultural Experiment Station of the Michigan State College, issued June 1928, contains a useful survey, by C. W. Bennett, of the diseases of the raspberry. This plant is cultivated to a considerable extent in Michigan, where there are probably 10,000 acres under cultivation with this fruit, so that with a large number of varieties grown in close proximity, valuable experience must have been gained of most of the pests encountered during the cultivation of this fruit. Several varieties of virus disease are recorded. These have so far usually been grouped together under the term of 'yellows,' but Bennett distinguishes between 'curl,' 'mosaic,' and 'streak'; of these, 'mosaic' seems the most common. For all of them control seems restricted to 'roguing,' with prevention of aphis infestation. Typical crown-gall is described for raspberry, also a rust, an anthracnose, a wilt, powdery mildew, and a blight of the cane and another of the spur. A leaf-spot is described, but as usual is of little economic importance. Red varieties of raspberry seem to act as carriers of virus diseases which do them little harm, but produce serious damage when they spread to the black varieties. The symptoms of these various diseases are described, and the causal organism defined, except of course for the virus diseases. Probably the anatomy of the raspberry

shoot, in which a resistant endodermis forms along the internode at an early period and continues into the base of the leaf and the axillary bud (NATURE, vol. 119, p. 35, Jan. 1, 1927), explains why many of these diseases only do serious harm when attacking the young shoots of the current year's canes.

EFFECTS OF MOISTURE CHANGES ON BUILDING MATERIALS.—The Department of Scientific and Industrial Research has recently issued a *Building Research Bulletin* (No. 3) by R. E. Stradling on the effects of moisture changes on building materials. Disintegration of material may occur through water entering into chemical combination with certain constituents, such as lime formed during the firing of a brick or tile made from clay with a high chalk content. The effect of frost is also under investigation, but it is uncertain whether the freezing of wet stone in England is responsible for much damage. Considerable decay may be caused at the junction of two kinds of material by the solution of some constituent of one layer followed by its crystallisation in the other. Building materials frequently contain 'sorbed' water which is in a condition intermediate between the water of chemical combination and 'free' water, and the rôle played by such water is being carefully studied. The sorption of moisture causes an expansion of the material, which is followed by a contraction when the humidity of the air decreases. Considerable strains are thus set up and failures may occur, especially at the junction of materials having different moisture expansions.

AN EASILY REGULATED SELENIUM RESISTANCE.—A form of selenium resistance, showing behaviour analogous to that of the ordinary selenium cell, is described by Prof. Lavoro Amaduzzi in the *Rendiconti della Reale Accademia delle Scienze dell' Instituto di Bologna* for 1926 (recently received). It is prepared by incorporating graphite uniformly in the fused selenium, and spreading the mixture in a layer on a plane strip of steatite. Two parallel metallic wires, constituting the poles or electrodes of the cell, may be pressed lightly on to the layer, and if one of these be fixed, movement of the other in one direction or the other will increase or diminish the resistance of the cell.

KRYPTON AND XENON.—A process described by M. Georges Claude in the issue of *Comptes rendus* of the Paris Academy of Sciences for Oct. 8 seems likely to make krypton and xenon available in relatively large quantities. It appears that the great difficulty encountered hitherto in their preparation with ordinary liquid air plant has been that instead of remaining dissolved in the higher boiling parts of the liquefied oxygen, they were largely carried away mechanically in the spray formed in fractionation. M. Claude therefore proposes to feed the liquid oxygen into the top of a species of rectifying column, where the ascending vapour is washed thoroughly by descending liquid, with the result that the small quantity of liquid that ultimately reaches the bottom is now rich in the heavy components. This is drawn off, and its krypton and xenon content raised from one part in a thousand to two parts in a hundred, by removal of part of the oxygen by combustion with hydrogen; the residual gas is then absorbed on silica and fractionated, yielding almost half of the krypton and xenon that was present in the air originally taken into the liquefier. The feature of the new apparatus is that existing machinery is readily adapted to include it, and M. Claude estimates that a big installation, such as that at Boulogne, which uses 3000 cubic metres of air per hour, could produce several tens of litres of krypton gas in a day's working, and about one-tenth this amount of xenon.

LIGHTING AEROPLANE ROUTES.—A summary of an American report on the applications of lighting for various novel purposes is given in the *Illuminating Engineer* for September and October. In the United States there are about 6000 miles of air routes which are provided with beacon lights not more than 10 miles apart, and illuminated intermediate landing fields 30 miles apart. The beacon lights are erected on steel towers about 70 feet high, at the bases of which are chrome yellow arrows 56 feet long which indicate the line of flight. For daytime identification the number of the beacon is painted in black on the arrow. The beacon develops a beam the intensity of which is about two million candle-power. Its axis is elevated about two degrees above the horizontal and it makes six revolutions per minute. The intermediate landing fields usually have two landing strips at right angles to one another, each of them being about 500 feet wide and 2000 feet long. The boundaries of the landing strips are marked out by white lamps; green lights mark the favourable approaches, and lamps in red globes are mounted on all neighbouring obstructions. Successful experiments have been made on controlling landing field floodlights by switches actuated either by the noise of the aeroplane or by a whistle of distinctive tone sounded from the aeroplane. Artificial lighting of areas devoted to recreational purposes is now extensively used, and it seems probable that baseball will soon be played at night time under artificial lighting. Under water lamps have been used for studying tropical marine life off the coast of Haïti. Both clear and coloured lamps were used, and the power of light to attract certain kinds of fish was demonstrated. In agriculture the attraction that light has for certain insect pests has been utilised in luring them to destruction.

MOTIONS OF ELECTRONS IN GASES.—There is a widespread feeling that the investigations of the motion of slow electrons in gases which have been made in the Electrical Laboratory at Oxford are incompatible with other experiments having a similar aim which have been performed elsewhere, and a recent statement to this effect has drawn the reply from Prof. J. S. Townsend which appears in pp. 511-523 of vol. 120 of the *Proceedings of the Royal Society*. There is no doubt that some of the adverse criticisms that have been levelled against his work would not have been made if his postulates and results had been more carefully examined. In other instances, the issue is less clear, but quite apart from controversial points, Prof. Townsend's contributions to the subject are unquestionably fundamentally important. To mention only two results, it has been established by him, or under his direction, that the collisions of slow electrons with molecules are almost perfectly elastic if no quantised transitions are excited in the interaction, and also that the mean free path of an electron depends upon its velocity of agitation. Again, as he points out, his work has been accepted as being of importance by the compilers of many of the standard text-books on the electrical properties of gases, particularly in its relation to sparking potentials; nor is there really any indication that the usefulness of his conceptions is exhausted, since in at least two recent instances, to which he does not refer, they have been applied with conspicuous success to fresh problems in gaseous conduction—by Dr. I. Langmuir and H. Mott-Smith to the action of a magnetic field upon the mercury arc, and by Prof. K. T. Compton and P. M. Morse to the theory of the so-called normal cathode fall of potential in a cold Geissler discharge.

The International Institute of Bibliography.

ANNUAL MEETING AT COLOGNE.

THE annual meeting of the Brussels Institut International de Bibliographie was held at Cologne on Sept. 18 and 19, and by invitation of the Oberburgermeister, Dr. Adenauer, the proceedings took place in the Petite Salle des Congrès of the 'Pressa' Exhibition. Delegates of a number of institutions in different parts of the world, interested in bibliography and bibliographical methods, were present. The Science Library, South Kensington, was represented by Dr. S. C. Bradford.

The proceedings were presided over by Prof. A. F. C. Pollard, of the Imperial College of Science, South Kensington. In his introductory address, Prof. Pollard, reviewing the organisation of the International Institute, suggested that a central daughter bibliographical society should be formed in each country in order that individuals and institutions interested in bibliography and bibliographical methods might become members of their national society, and instanced the recent formation in London of the British Society of International Bibliography (British Section of the Institut International de Bibliographie).

Prof. Pollard then proceeded to indicate the possible relation of these societies to the Institut International de Bibliographie for the purpose of securing international uniformity of bibliographical method and the application of the universal decimal classification which had been so highly developed by the Institut. He hoped that by such means the extensive but wasteful energy expended upon the innumerable bibliographies at present published upon almost every branch of learning, and in many instances utilising extraordinary and useless methods of subject matter reference, might be directed into the production of bibliographies usefully indexed upon the simple and universal system advocated by the Institut. In the field of science some of these bibliographies might replace the International Catalogue of Scientific Literature, the cessation of which was a great loss to science.

Prof. Pollard pointed out that the Optical Society of London was the first scientific society in England to adopt these methods for indexing its *Transactions*. If all scientific societies agreed to act in the same uniform manner, and these several indexes were collected and published as specific bibliographies by the central body or Institut International de Bibliographie, accurate and detailed references to scientific literature would be produced with maximum economy and minimum effort. Such an international organisation for scientific literature, if it ever came about, might be extended to all fields of intellectual activity, and a gigantic machine could be established to index the world's rapidly increasing mass of literature. This was not an impossibility, for it only required concerted action, financial support, and the use of the powerful bibliographical tools which had been offered to the world by the Institut for the last twenty-three years.

The morning of the first day was occupied by the business of the Council, and in the afternoon the meeting of the Commission de la Classification Decimale was held. The function of this important commission or committee of the Institut is principally concerned with the periodical revision of the decimal classification, which by the aid of many collaborators in different parts of the world is ably conducted by M. Donker Duyvis, of Deventer. During the discussion upon the new edition of the Classification Decimale Universelle, now in course of preparation, it was stated that the Science Library was preparing an English index, the German Committee had decided upon a German translation of the work, and that in Czechoslovakia a translation had already been started.

On the following day the assembly, consisting of all members of the Institut and numerous delegates, convened to receive reports and hold discussions during which many interesting activities were brought to light. In particular, Dr. Huet, of Brussels, is producing by the help of collaborators an extensive bibliography of dentistry. Czechoslovakia gave evidence of the application of the international decimal classification in many directions. A remarkable feature of these deliberations was the unanimous tribute paid by a number of representatives of various municipal bodies to the great utility of the international classification for the efficient and rapid selection of any required detail from municipal archives, a very severe test of practical utility.

MM. Paul Otlet and H. La Fontaine, the original founders of the Institut International de Bibliographie in 1895, directed attention to the necessity of finding a suitable home for the Universal Bibliographical Repertory, consisting of 13,667,816 moveable index cards at present housed at the Palais Mondial at Brussels, which may shortly have to be removed. They hoped that it might be possible to find a suitable place for this enormous index in Geneva.

Dr. Uhlendahl, director of the German library at Leipzig, who also represented the Association of German Booksellers and the International Union of Librarians, pointed out, in his vote of thanks to the president, that the number of German librarians present was an indication of the interest taken in the methods of the Institut in Germany, and referred to the satisfactory progress made in various directions as shown by the reports received at the conference.

The Oberburgermeister of Cologne invited the members of the conference to luncheon in the Rathaus, and those who were present will not readily forget his liberal hospitality or the comfortable accommodation he afforded the members of the conference in the 'Pressa' Exhibition.

S. C. BRADFORD.

Economics of Production.

DISCUSSING "Medieval Economic Theory in Modern Industrial Life," Prof. Mauritz Bonn, of Berlin, before Section F (Economic Science and Statistics) at the recent Glasgow meeting of the British Association, stated that the chief feature of medieval economic theory was probably the conception of production as a mere physical act of turning out goods. The money value side of it was of no importance. In strict accordance with this conception, distribution proper, outside physical transportation, was rather despised. Price was a kind of simple computation of different costs; costs being equivalent to actual outlay and the necessary expenses of maintaining a status of living. The price was 'just' when the return to the producer covered these elements.

The scarcity of goods caused by the War in many countries brought the conception of physical production again to the forefront. Inflation enormously strengthened this conception. The less trustworthy the purchasing power of money, the more important was the possession of actual goods. The scramble for goods led to the theory that prices ought to pay, not for the actual cost of production of the goods sold, but for their cost of reproduction.

War and inflation had had a great influence on the fate of the purely commercial classes. Distribution was considered a more parasitical undertaking. This reduced position of commerce enabled the manufacturing element to push forward with a policy they had embarked upon before the War—the ousting of the trader. The tendency which was visible in Germany before the War of industrial concerns trying to eliminate the trader by erecting their own distributing agencies greatly increased as the result of voluntary or compulsory cartellisation. The purely physical conception of production was most clearly visible in the attitude taken by business people in their relation of creditor and debtor. The debtor in their minds was a producer who carried out technical and economically important functions. The creditor, if not an industrial producer himself, was a kind of leech sucking the life-blood of the industry. These views, influenced no doubt by a very short-sighted self-interest, were clearly akin to the medieval attitude to usury. Even since stabilisation has been accomplished, these views have not changed very much. The theory of prices underlying development in what might be called the era of competition, had been due to the conviction that low prices were a boon to society and that economic progress was identical with slowly falling prices. The medieval theory was the same in so far as consumers' interests came first. It believed, however, in stability, as without some stability the functional income of the producer could not be maintained.

The theory that falling prices conferred a benefit on mankind is now being deserted. Instead of it, a theory is growing up that rising prices, by giving a stimulus to production, are the real solution of social problems. First came Protection, which tried to raise prices for certain selected privileged goods, its advocates maintaining all the time that the general level of prices would not be affected. Then came inflation, with its spurious boom, which owing to rising prices was supposed to expand production. When carried out to its bitter end, as it was in Germany, it certainly had not produced the much-advertised benefits. After these not over-favourable experiences with wholesale inflation came the theory of homœopathic inflation, its advocates maintaining that by proper dosing of credit, stabilisation of sorts could be secured. Prices must not be allowed to fall under any conditions; wherever there was a tendency to fall, the issue of credit or the floating of loans abroad must prevent them sagging.

The theory of stabilised prices, which in its practical bearing was eagerly absorbed by business men, who cared nothing for its theoretical meaning, was closely affiliated to the medieval conception of maintaining a certain social order and a certain individual income. This is clearly demonstrated by the practice of many cartels. The question to be discussed is not free competition or monopoly; it is the peculiar form of monopoly aimed at or achieved by some influential cartels. The type of cartel in question is an agreement by which the individual works bound themselves to trade their produce by some sort of joint selling agency and to restrict their output if necessary. Now this sort of cartel is not based on any modern conception of efficiency. It standardises inefficiency at the cost of the consumer.

When comparisons have been made between trusts and cartels, cartels have always been praised for the maintenance of a number of separate enterprises. Where in a trust the initiative of leadership is reduced to a single head or to a small group of persons, the parties of a cartel continue as individual 'Captains of Industry.' As a matter of fact, they remain technical managers of their individual concerns, freed from the necessity and possibility of selling the produce they turn out. They are utterly divorced from the mere business side of their job, the marketing of their goods. The price fixed by the syndicate must be high enough to yield an income, though these works are run at half capacity and ought not to be run at all. It had often been said that the price must be high enough to keep the worst concern going. The trust need not be badly financed, but it is almost a law of Nature that the firms forming a cartel must. A trust may have many of the advantages claimed by the cartel, though some form of control was required. Real progress in a capitalistic world is, however, impossible without writing off, whereas cartels are essentially a well thought-out system of maintaining inflated capital values. The right to profit, to rents, and even to unearned increment, which the capitalistic system has conceded to private enterprise, must be counterbalanced under the system by a corresponding obligation to loss.

Examinations—The New Compromise.

THE Departmental Committee on Examinations for Part-time Students was appointed in 1927 "to inquire and report as to the arrangements for the examination of students attending part-time schools under the regulations for further education, with particular reference to the place and value of examinations as an element in training for industrial, commercial, and professional activity." Its report has just been published (London: H.M. Stationery Office, 1s. net), and contains chapters—notably those on the purpose of examinations and the planning and conduct of examinations—which should be read by all teachers. It will be of special interest to teachers in technical institutions, since they particularly will be affected by its recommendations.

Briefly, the report recommends a compromise. For some years now there has been a sharp division between supporters of the purely external and of the purely internal systems of examination. Indeed, the controversy which the report is expected to settle may be traced back to 1911, when the Board of Education's Circular 776 withdrew the old Science and Art Examinations and gave freedom to institutions to organise internal examinations, the final certificate of which would be endorsed by the Board. But it appears that the scheme has not been widely used, and the weakness would appear to have lain in the fact that many part-time classes are taught by part-time teachers who are sometimes not expert in setting and marking papers. But this was not the only cause of the failure of purely internal examinations. Most part-time students take courses in order to benefit vocationally. They therefore need a certificate of which employers all over Great Britain will recognise the value. The certificate granted by a school as a result of an internal examination does not yet fulfil that condition.

Many teachers have naturally desired to retain the principles of Circular 776, which they regarded as a charter of freedom, and the time will doubtless come when those sound principles will be found generally practicable. In the meantime, the present report sees the value, particularly in their possibilities of counting such important things as laboratory and home work, of internal examinations. But it also sees their present defects, and has decided upon a compromise in the form of modified external examinations. It envisages a system in which they are

conducted by unions of local education authorities throughout Great Britain.

Whether such groups of unions will, in fact, do all the report expects, is not a matter upon which any pronouncement can be made now. From the recommendations made, however, it may be possible that ultimately a more ideal system can be built. It is a pity that, in the report itself, no mention was made of the future possibilities when the obstacles to the excellent principles of Circular 776 will be swept away. If examination, as the report wisely shows, is an educational function, hope still stays with the idealist; for in education "nothing is constant but change."

Origin and Structure of the Viviparidæ.

TWO exceedingly important papers by Dr. Baini Prashad have appeared, nominally concerned only with the Viviparidæ, but in reality covering far wider ground (*Mem. Indian Mus.*, vol. 8).

The first deals with the recent and fossil Viviparidæ and constitutes a study in distribution, evolution, and palæogeography. The author attempts to determine the taxonomy of the family, the dispersal of which he considers to have taken place along the freshwater streams. The ordinary zoogeographical regions are of no value for the Viviparidæ, which are, therefore, considered here according to the continents and countries in which they are found, a sketch map being appended. The fossil members are treated on similar lines and genealogical trees given. The various sculptured forms are held to have been independently evolved in the different regions, and their palæogeography is discussed so far as it has a bearing on the subject in hand.

Setting aside Garwood's *Viviparus carbonarius*, for reasons which some will consider insufficient, the author holds that the Viviparidæ arose from the common stem of the families Trochidæ and Turbinidæ in the early Jurassic period, not, however, from a common ancestral form, but polyphyletically, taking to freshwater life in at least four regions, namely, western Europe, North America, peninsular India, and Australia. The probable time of origin in each area, the evolution of the different subgenera, and the lines of migration are then discussed.

Dr. Prashad's second paper, "On the Mantle and Shell of the Viviparidæ," was undertaken in continuation of the work of his late chief, Dr. T. N. Annandale, on the problem of the shell sculpture in the family. After a preliminary historical sketch of the relation between the shell and the animal in Gastropoda, the author passes to a detailed study of the mantle of the Viviparidæ, the important difference of which, contrasted with that of other gastropods, lies in the development of special processes on the mantle margin of the embryos, some of which also persist in the adults. There are three primary and a number of secondary and tertiary processes which correspond to the ridges or sculpture on the shells. The section dealing with the shell is in matter of fact an able summary of all that is known concerning the structure and formation of gastropod shells as a whole and should be overlooked by no malacologist.

The paper concludes with a "Review of the Literature on the Embryonic Shell-gland and Associated Structures in Mollusca," and a bibliography. The plates, five in all, are excellent specimens of photolithography, and the whole work (pp. 167) reflects the greatest credit on those responsible for its production, including the Zoological Survey of India, which in a sense is the parent of it.

University and Educational Intelligence.

CAMBRIDGE.—Mr. C. Warburton, Christ's College, has been re-appointed demonstrator in medical entomology. Miss A. S. Dale, Newnham College, has been elected to the Michael Foster research studentship in physiology. Mr. H. J. Pfister, of the University of Birmingham, has been nominated to use the University's table at the Zoological station at Naples for one month.

LONDON.—The new statutes have been submitted to His Majesty in Council. Eight weeks from the commencement of term will be allowed for petitions. We understand that a petition has been presented by a member of Convocation for the disallowance of certain statutes nullifying or restricting the privileges of Convocation in relation to the appointment of its clerk and the approval of new statutes. The same petition objects to the exclusion of the Royal College of Science, London, from the list of Schools of the University in the Faculty of Science, on the ground that the College became a School of the University in the Faculty of Science under the statutes of 1900 and has not lost that status. The statutes were sealed by the Commissioners on July 23, 1928.

OXFORD.—On Tuesday, Oct. 23, Congregation had two measures before it, both of which raised questions of interest to scientific men. By the first of these it was proposed to curtail the present permission of research students in letters or science to reckon periods of residence in vacation towards their statutable terms for the degrees B.Litt. or B.Sc. respectively. It was pointed out by Prof. E. B. Poulton that the opportunities for the requisite study were at least as open in vacation as in term, and that the effect of the proposed statute might well be to put great difficulty in the way, for example, of aspirants to the science degree domiciled in distant countries and with limited periods of leave. The preamble was rejected by 88 votes to 80.

The second, a decree supported by the Provost of Worcester and Dr. J. Wells, and opposed by Sir Harold Hartley and Mr. A. H. Smith, proposed the acceptance of a generous gift of £10,000 by Prof. Joseph Wright towards the cost of extending the Taylorian Institution along the front of St. Giles's. Ungracious as it seemed to decline so munificent an offer, it was felt that the conditions attached to the gift were not in the best interest of the institution concerned, nor ultimately in that of the University. The question of provision for the future housing and extension of the Ashmolean collections, of unique scientific and archæological value, is involved; and it appeared to the majority that a more considered and wider scheme was called for than that recommended by Council. The decree failed to pass, there being 92 votes for it and 121 against.

An equally liberal gift of £10,000 from Capt. Brynar Owen and Mr. W. J. Mallinson for the purpose of engineering research in connexion with the Institute of Agricultural Engineering was gratefully accepted.

THE Institution of Chemical Engineers announces that application forms and particulars of the associate-membership examination for 1929, together with a memorandum on "The Training of a Chemical Engineer," may be had from the Honorary Registrar of the Institution, Abbey House, Westminster, S.W.1. The application forms referred to must be returned by Dec. 15.

Calendar of Customs and Festivals.

November 3.

ST. WINIFRED—Virgin and Martyr.—The well of St. Winifred at Treffynnon, also known as Holywell, was at one time one of the best known and most frequented wells in Great Britain. The cult of the Saint at this spot has with some probability been traced to Saxon times, but it unquestionably superseded an older worship. It was much frequented by pilgrims, and was noted for its healing qualities. The rites took the usual form of circumambulation, bathing, kissing certain stones, and a large number of votive offerings, especially crutches, bore witness to its healing qualities. A small spring near the great well was noted for the cure of weak eyes, sufferers offering crooked pins.

November 5.

GUNPOWDER PLOT. GUY FAWKES DAY.—The public celebration of the discovery of the plot to blow King and Parliament on Nov. 5, 1605, has now len into disuse, though its memory is preserved in e discharge of fireworks by children, and the parade 'guys' about the streets on Nov. 5 and preceding ys with the object of raising a few coppers. The propriate and widely distributed rhymes beginning Remember, remember the fifth of November," are ll sometimes heard. Public celebration lasted well to the nineteenth century, and so late as the venties it was recorded that the Yeomen of the uard searched for any barrels of gunpowder which ght be hidden in the vaults of the Houses of Parliaent. In London one of the biggest of the bonfires as lit at the corner of Lincoln's Inn Fields on the eat Queen Street corner, when sometimes as many two hundred cartloads of wood and more than irty 'guys' were consumed. The processions were t always of a peaceful character, and rival 'guys' om different districts sometimes became involved in hts of a more or less serious character.

Among the butchers of Clare Market the celebraons took on a special character. One of their umber personated the 'guy' and, being seated in a rt with a prayer book, was drawn about in the mpany of an executioner and priest. A select party ith marrow bones and cleavers headed the procesn, while others solicited alms which were spent at e ale-house on a feast at the end of the day.

At Harlington, under date 1683, half an acre of nd was given for the benefit of the bellringers of the arish to provide them with a leg of pork for ringing e bells on Nov. 5.

The Fifth of November custom is widespread in ngland, and although the accompanying rhymes ary in detail, essentially they are identical. Certain ariations in custom are recorded which are not ithout significance. In Oxfordshire the verses were ecited while the fuel was being gathered, and were eld to render lawful the appropriation of any old ood. The operation was known as 'going arogging.' At Lewes a torchlight procession took lace, those participating being dressed up, with lackened faces. Effigies were cast into the fire when t was at its highest. At Marlborough a dozen or nore formed a ring around the fire and they then ollowed one another round it in a circle, holding hick club-sticks over their shoulders, while others standing outside the circle beat the sticks of those in he circle with similar sticks as they passed. All shouted at the top of their voices. This lasted for about half an hour, and was repeated at intervals until the fire died out. In the West Riding of Yorkshire for some weeks before, a store of the cake called Parkin was prepared which was solemnly eaten on the day. At Doncaster the town waits played on the church steeple, for which they received sixpence.

A further indication of the ritual character of the Fifth of November festival is afforded by Lincolnshire and Yorkshire belief and practice. Some seventy or eighty years ago it was held that on Nov. 5 any farmer's son or, in some localities anyone, could shoot at will on neighbours' farms or their preserves. It is recorded that between 1805 and 1825 everyone who could procure a gun would turn out to shoot, and no one thought of preventing them.

The survival of these variations in practice points to what at one time must have been a more elaborate ceremonial. The Marlborough custom is very distinctly of a religious and sacrificial character. The widespread Fifth of November fire has clearly taken the place of the Samhain fires of Wales, Scotland, and Ireland.

November 6.

ST. LEONARD.—A French nobleman of the court of Clovis I. converted by St. Remigius, who became a monk remarkable for his charity towards prisoners, and died in 559. His miraculous efforts in releasing prisoners continuing after his death, he was canonised. An Ordinance of Worcester, published in 1240, ordained that his day should be kept a half-holiday, and that on it there should be no labour except that of the plough. In one of the Essex manors dues on animals, especially pigs, were payable on this day for the privilege of the manorial woods.

October-November.

In the Bombay Presidency on the twelfth day of the dark half of the month Kārtik, some villages of the Thana district of the Bombay Presidency worship the deity Waghoba or Waghya. The cowherds collect a quantity of milk and prepare a mixture of cooked rice and molasses. They then proceed to the stone image of the deity in the jungle and besmear it with new red lead, pour sweet milk over the stones, pray for the protection of the cattle, and partake of the remaining milk. An interesting ceremony, which recalls the English 'beating the bounds,' is performed at Agashi and neighbouring villages, when a goat and some cocks are sacrificed to the spirits in the cemeteries and at the boundary of the village. A goat decorated with garlands and red powder is made to walk round the village three times at night accompanied by the villagers, who scatter parched rice as they pass. This is called 'binding the boundary' and protects the cattle and crops. No farmer dares sow his seed until this rite has been performed.

November.

In Malabar, in connexion with the cultivation of the second crop, a ceremony is held in honour of the god Muni in the month of Thulam (November). Each barn has its own Muni represented by a block of granite beneath a tree. He is the protector of cattle and field labourers, and arrack, toddy, and blood are necessary ingredients of his worship. In well-to-do families a goat, in the poorer a fowl, is sacrificed to him, the officiating priest being a Nayar or a Cheruman. The goat or fowl is brought before the god and a mixture of turmeric and lime sprinkled on it. If the animal shakes, the god is satisfied. The fact that the officiating priest is a Cheruman is significant, as they are serfs. The prominent position that they and other servile tribes take in these ceremonies is interpreted as a mark of recognition that they were once masters of the land, a fact to which Kipling refers in connexion with the Bhils in one of his Indian stories.

Societies and Academies.

SYDNEY.

Linnean Society of New South Wales, Aug. 29.—**C. P. Alexander**: The Tanyderidæ (Diptera) of Australia. The family Tanyderidæ is represented by ten recent and fossil genera; of these, three genera with four species are here recorded from the Australian subregion.—**Rev. H. M. R. Rupp**: Terrestrial orchids of Barrington Tops. During a visit paid in January last, abundant material of *Diuris venosa* was obtained. Southern forms discovered on the plateau were *Pterostylis falcata*, *P. decurva*, *Prasophyllum Suttonii*, and *Chiloglottis Gunnii*; while evidences of *Adenochilus Nortonii*, hitherto only recorded from the Blue Mountains, were found. Altogether, 23 species of terrestrial orchids were collected. Two species of *Prasophyllum* are described as new.—**F. H. S. Roberts**: A revision of the Australian Bombyliidæ (Diptera). Part 2. This part includes the revision of the subfamily Bombyliinæ. Five genera are placed in this subfamily, namely, *Bombylius*, *Systoechus*, *Sisyromyia*, *Dischistus*, and *Anastœchus*. 36 species are described, 15 of which are regarded as new. The genus *Anastœchus* is recorded for the first time from Australia.—**G. A. Waterhouse**: Notes on Australian Lycænidæ. Part 6. New subspecies of *Candalides heathi*, *Miletus apollo*, and *Pseudalmenus chlorinda* are described. *Miletus delicia* ab. *duaringæ*, originally described from a single male, is the northern race of this species, while *Philiris* is a genus distinct from *Candalides*. The species *Lycæna? byzos* Boisd., described in 1832, is considered to be a *Miletus*, identical with the specimens of *M. hecalius* found near Sydney.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 8, August).—**Robert E. Burk**: The thermal decomposition of ammonia upon mixed surfaces of tungsten and platinum. The velocity of decomposition is greater on a surface alloy than on an equal area of either tungsten or platinum, and the temperature coefficient is smaller. This points to separation of the atoms forming the bond as the mechanism.—**Linus Pauling**: The crystal structure of topaz. Using the co-ordination theory of ionic crystals, it is assumed that the fundamental polyhedra are an octahedron of anions (oxygen and fluorine) about each aluminium ion and a tetrahedron of oxygen ions about each silicon ion. Four layers of these polyhedra form an arrangement giving a space group of V_h^{16}, and the unit contains 4 $Al_2SiO_4F_2$.—**Sam Lenher and Farrington Daniels**: The intensive drying of liquids. Organic liquids were sealed up in glass and quartz tubes with phosphorus pentoxide. After about four years, certain of these, containing benzene and carbon tetrachloride, were opened and the boiling points determined. No abnormal rise of boiling points was observed.—**Oliver R. Wulf**: (1) A progression relation in the molecular spectrum of oxygen occurring in the liquid and in the gas at high pressure. Several bands just to the red of complete absorption (about 2400 A.) appear to be due to the molecule O_4.—(2) The heat of dissociation of oxygen as estimated from photochemical ozonisation.—**G. L. Clark, A. J. King, and J. F. Hyde**: The crystalline structures of the alkaline earth metals. Calcium, strontium, and barium of purity exceeding 99·9 per cent have been prepared for X-ray analysis, great precautions being taken against oxidation. Barium crystallises in the cubic system, the unit cell contains two atoms, and its constant is 5·04 A.; the intensities of the lines indicate a body-centred cubic lattice. Strontium did not give sharp lines; possibly ...ture be-... **L. H. Germer**: ... C. J. Davisson and ... ion and refraction of electrons by a crystal of nickel. Further observations support the view that electron refraction in the optical sense is a property of the crystal, and that the indices are greater than unity. At bombarding potentials below 150 volts, however, the value of the refractive index seems to change with wave-length, and may be dependent on the order of the reflection.—**Irving Langmuir**: Oscillations in ionised gases. Oscillations of small amplitude (less than 0·2 volt), and of frequencies up to $1·2 \times 10^9$, have been observed; an explanation is offered (*v.* NATURE, Oct. 20, p. 626).—**Robert A. Millikan and G. Harvey Cameron**: Evidence that the cosmic rays originate in interstellar space. Experiment shows (1) the abundance of positive and negative electrons in interstellar space; (2) that these electrons condense into atoms; (3) that these atoms aggregate under their gravitational forces into stars; (4) that occasionally a positive and negative electron in the interior of a star are transformed into an ether pulse. If this atom-building process is going on, it is reasonable to suppose that the supply of positive and negative electrons is continually being replenished by the condensation, by some unknown mechanism, of radiant heat.—**Carl Barus**: The displacement interferometry of barometric pressure.—**Jared Kirtland Morse**: The structure of acetylene. If the carbon atom be represented by a cube, the nucleus being at the centre and the *L*-electron positions at the corners, a model acetylene molecule can be built up, the constants of which agree with those determined from analysis of the infra-red band spectrum, as has previously been described for ethane and methane.—**E. R. Hedrick**: On derivatives of nonanalytic functions.—**G. Y. Rainich**: Radiation and relativity (2).—**Gordon T. Whyburn**: Concerning plane closed point sets which are accessible from certain subsets of their complements.—**Joseph Miller Thomas**: Incomplete systems of partial differential equations.—**Th. Dobzhansky**: The effect of temperature on the viability of superfemales in *Drosophila melanogaster*. The viability of superfemales, which carry three *X*-chromosomes and two sets of autosomes, is greatest at about 20° C. Both high and low temperatures increase the breaking apart of the attached *X*-chromosomes.—**A. V. Bock, P. S. Bauer, and J. H. Means**: Preliminary note on the elastic hysteresis of the human aorta. The arch of the aorta is tied on to a water-mercury manometer, and after increasing the internal pressure monotonically to a maximum, the pressure is decreased by steps, the internal volume of the aorta being measured at each step. The loss of heat energy can be calculated, and also the efficiency. Assuming that the metabolic demands of the human system at 78 years are the same as before advanced changes occur in the arterial system, 45 per cent of the heart's energy output is lost as heat, compared with 25 per cent at 41 years, or the work of the heart must increase 20 per cent as a result of arteriosclerosis to maintain the same blood flow.

Official Publications Received.

BRITISH.

Professional Schools Post-Graduation Courses: Specialist Studies in the Universities and University Colleges of Great Britain and Ireland. Session 1928–9. Pp. 39. (London: Universities Bureau of the British Empire.)

Bulletin of the Raffles Museum, Singapore, Straits Settlements. No. 1, September. Pp. ii+44+2 plates. (Singapore.) 60 cents; 1*s*. 6*d*.

Records of the Geological Survey of India. Vol. 60, Part 4. Pp. 313-... +xxix+plates 26-39. 2.12 rupees; 5*s*. Vol. 61, Part 3. Pp. 207-325+plates 21-25. 2.12 rupees; 5*s*. (Calcutta: Government of India Central Publication Branch.)

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Seeds Mixture Problems: Competition. By R. G. Stapledon and Wm. Davies. (Series H, No. 8, Seasons 1921–1926.) Pp. 162. (Aberystwyth.) 3s. 6d.

Ceylon. Administration Report of the Director of Agriculture for 1927. Part IV. (Colombo: Government Record Office.) 75 cents.

Proceedings of the Royal Society of Victoria. Vol. 40 (New Series), Part 2. Pp. 57-107. (Melbourne.)

Ceylon: Department of Agriculture. Technical Reports for the Year 1927. Pp. 11+15+6+10+40. Reports of Divisional Agricultural Officers for the Year 1927. Pp. 22+18+22+22. (Colombo.)

University College of North Wales. Calendar for Session 1928–29. Pp. 199. (Bangor.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 382, October. Pp. 1005-1100+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1148 (M. 54): The Behaviour of a Single Crystal of a-Iron subjected to Alternating Torsional Stresses. By Dr. H. Gough. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 200.) Pp. 84+24 plates. 2s. 3d. net. No. 1158 (Ae. 318): Experiments with the Family of Airscrews in Free Air at Zero Advance. By H. C. H. Townend, W. S. Walker and J. H. Warsap. (T. 2549.) Pp. 10+6 plates. 1s. net. (London: H.M. Stationery Office.)

Journal of the Royal Statistical Society. Vol. 91, Part 4. Pp. 468-632+xxx+vii. (London.) 7s. 6d.

University of London: University College. Calendar, Session 1928–1929. Pp. lxxx+10+491+lxxxi-cxciv+89. (London.)

FOREIGN.

Department of Commerce: Bureau of Mines. Technical Paper 434: Geophysical Prospecting; some Electrical Methods. By A. S. Eve and D. A. Keys. Pp. v+41. (Washington, D.C.: Government Printing Office.) 10 cents.

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 39: Über die Herstellung und die mechanischen Eigenschaften des Duralumins. Von Masaharu Goto, Sin-ichi Fukuta, Sadao Horiguchi und Tenji Nagai. Pp. 271-403. 1.30 yen. No. 40: On the Inverse Wiedemann Effect and its Allied Phenomena. By Tatuo Kobayasi, Hiroto Okumura and Kinnatu Sunamura. Pp. 405-460. 0.61 yen. No. 41: On the Effect of Temperature Changes upon an Altimeter. By T. Sasaki, K. Hattori, I. Hagiwara and R. Tate. Pp. 461-496. 0.40 yen. (Tokyo: Koseikai Publishing Office.)

Union Géodésique et Géophysique Internationale. Troisième assemblée générale, Prague, Septembre 1927. Procès-verbaux des séances de la Section de Météorologie. Pp. 104. (Rome: G. Bardi.)

Department of Commerce: Bureau of Standards. Research Paper No. 1: Accelerated Tests of Organic Protective Coatings. By Percy H. Walker and E. F. Hickson. Pp. 17+4 plates. 5 cents. Research Paper No. 2: Measurement of the Tread Movement of Pneumatic Tires and a Discussion of the Probable Relation to Tread Wear. By W. L. Holt and C. M. Cook. Pp. 19-28+3 plates. 5 cents. Research Paper No. 3: Absolute Methods in Reflectometry. By H. J. McNicholas. Pp. 29-73. 10 cents. Research Paper No. 4: Interferometer Measurements of Wave Lengths in the Vacuum Arc Spectra of Titanium and other Elements. By C. C. Kiess. Pp. 75-90. 5 cents. Research Paper No. 5: Analysis of Bauxite and of Refractories of High Alumina Content. By G. E. F. Lundell and J. I. Hoffman. Pp. 91-104. 5 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

A Catalogue of Important and Rare Books on Botany, Agriculture, Forestry, Fruit-Culture, Gardens and Gardening, Herbals, Early and Modern Medicine and Surgery, Tobacco. (No. 420.) Pp. 148. (London: Bernard Quaritch, Ltd.)

Oxford University Press General Catalogue, 1928. Pp. xii+490+169. (London: Oxford University Press.)

Heat Treatment Bulletin, No. 41: The Hardening and Tempering of High Speed Steel. By A. R. Page. Pp. 7. (London: Wild-Barfield Electric Furnaces, Ltd.)

Catalogue of recent purchases of Important Works on Botany, Zoology, General Literature, etc. (No. 6.) Pp. 16. (London: John H. Knowles, 92 Solon Road, S.W.2.)

Early Newspapers, including Magazines, Periodicals and Journals of Learned Societies. (Catalogue 510.) Pp. 86. (London: Francis Edwards, Ltd.)

Catalogue of Important Botanical and Horticultural Works. (No. 168.) Pp. 38. (London: Dulau and Co., Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 2.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—S. Hastings: Presidential Address.—Dr. J. K. Love: A Classification of Deafness Based on the Effect of Deafness on Efficiency in Life.—Dr. T. A. Clarke: On Hearing Tests.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.—A. H. Mundey: Die Casting.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—H. B. Tawse: Some Unsolved Problems of Rhino-laryngology (Presidential Address).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Evolution of the Human Foot and its Bearing on Orthopaedic Disorders of the Foot.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—E. D. P. Evans: Wye Rivers.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at Surveyors' Institution), at 5.30.—Sir A. Daniel Hall: Samuel Pepys, Civil Servant and Fellow of the Society (Lecture).

[NORTH-EAST] COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Institute, Newcastle-upon-Tyne), at 6.—E. G. Barrilon: From Hydrodynamics to Practical Ship Design.

WOMEN'S ENGINEERING SOCIETY (at Lyceum Club, 138 Piccadilly), at 6.15.—Miss Rose E. Squire: History of Factory Legislation in Great Britain.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Sections of Institute of Chemistry, Society of Dyers and Colourists, and Manchester Literary and Philosophical Society) (at Engineers' Club, Manchester), at 7.—Sir John Russell: Application of Chemistry in Modern Farming.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.—Miss Agnes B. Warburg: Light and Space.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at University College, Swansea), at 7.30.—M. Jones: X-Rays (Lecture).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Cinematograph Film showing the Principle, Construction, Erection, and Operation of the Babcock Boiler.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Annual Conversazione.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—I. W. Magill: Endotracheal Anæsthesia.

SATURDAY, NOVEMBER 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. T. E. R. Phillips: Recent Observations and Discoveries respecting the Planets (I.).

MONDAY, NOVEMBER 5.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. T. J. Jehu: Obituary Notice of Dr. John Horne.—J. Mackie: Mathematical Consequences of Mental Ability.—J. R. Thompson: The General Expression for Boundary Conditions and the Limits of Correlation.—T. P. Black: Mental Measurement: the Probable Error of some Boundary Conditions in Diagnosing the Presence of Group and General Factors.—W. F. P. McLintock and J. Phemister: A Gravitational Survey over the Buried Kelvin Valley at Drumry near Glasgow.—*To be read by title*:—Sir T. Muir: The Theory of Bigradients from 1861 to 1919.—Dr. L. N. G. Filon: On a Quadrature Formula for Trigonometrical Integrals.—Prof. E. T. Whittaker: On the Theory of Mathieu Functions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—T. W. P. Lawrence: Demonstrations of Surgical Specimens.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—C. R. Enock: The Future of Engineering in the Light of Modern Economic Industrial and Political Conditions.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—W. T. Townend: Some Considerations of the Economics of Electric Power Production.

HUNTERIAN SOCIETY OF LONDON, at 7.30.—Dr. H. Dearden, Dame Madge Kendall, Sir St. Clair Thomson, Miss Lena Ashwell, and I. Back: Discussion on The Doctor on the Stage.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.20.—Presidential Address.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 8.30.—Discussion on Fibrosis of Lung.

SOCIETY OF CHEMICAL INDUSTRY (London Section).—H. S. Rowell: A New Carbonisation Test for Lubricating Oils.

TUESDAY, NOVEMBER 6.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. F. Still: The History of Pædiatrics to the End of the 16th Century (Fitzpatrick Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. L. Callendar: Co-aggregation *versus* Continuity in the Change of State from Liquid to Vapour (Tyndall Lectures) (II.).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Eleanor M. Brown: Exhibition of two Diatoms *Navicula subsalina* and *Cyclotella kuntzingiana*.—R. J. Wilkinson: Exhibition of Lepidoptera to illustrate a hitherto unrecognised Principle of Coloration.—Mary L. Hett: The Comparative Anatomy of the Palatine Tonsil.—J. R. Norman: The South American Characid Fishes of the Subfamily Serrasalmoninæ, with a Revision of the Genus *Serrasalmus* Lacépède.—Oldfield Thomas: Delacour Exploration of French Indo-China. Mammals. III. Mammals collected during the Winter 1927–1928.—G. Arrow: A Revision of the African Coleoptera belonging to the family Languriidæ.—S. Hirst: On some Australian Species of Trombidiidæ.

MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—F. A. Bannister: The so-called "Thermokalite" and the Existence of Sodium Bicarbonate as a Mineral.—W. A. Wooster: The Piezo-electric Effect of Diamond.—F. N. Ashcroft: Exhibit of Minerals Recently Collected in Switzerland.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Brodie Haldane Henderson: Presidential Address.

ILLUMINATING ENGINEERING SOCIETY (at Lighting Service Bureau, 15 Savoy Street), at 6.30.—J. S. Dow: Report on Progress during the Vacation.—C. C. Paterson: The International Illumination Congress in the United States.—Reports on Progress in Gas and Electric Lighting.

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—F. W. Spencer: Drop Forging and Machine Forging.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Late T. H. Greenall: Some Slides of Southern Italy.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Prof. C. H. Desch: Deformation of Metals.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—W. G. Richards: Chairman's Address.

WEDNESDAY, NOVEMBER 7.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 3.—E. E. Hoadley: The Electricity Supply Act, 1926.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. P. Gosse: Pirate Surgeons.—P. Flemming: The Medical Aspect of the Mediæval Monastery.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. L. F. Spath: The Recent Landslide in the Isle of Wight.—S. G. Clift and Dr. A. E. Trueman: The Sequence of Non-Marine Lamellibranchs in the Coal Measures of Nottinghamshire and Derbyshire.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Comdr. J. A. Slee: Chairman's Address.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—G. A. Cottell: Heating and Domestic Installations—the Insurance Point of View.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Institution of the Rubber Industry) (at Royal Philosophical Society, Glasgow), at 7.15.—W. H. Nuttall: Electrical Insulating Materials from a Chemical Standpoint.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—E. Hinchliffe: Chairman's Address.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 8.—Dr. L. Hunter: The Rôle of the Halogens in Organic Chemistry (Presidential Address).

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—J. Grant: Improved Method for the Determination of Small Quantities of Antimony in the Form of Stibine.—H. R. Ambler: Analysis of Small Samples of Gas.—E. Lester Smith: Determination of Unsaponifiable Matter in Oils and Fats.—P. Arup: Composition of Irish Butter.—Dr. H. B. Dunnicliff: Volumetric Determination of Mercury.

ROYAL SOCIETY OF ARTS, at 8.30.—Sir George Sutton, Bart.: Fifty Years of British Industry.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Sir Holburt Waring: Surgical Education and Surgical Practice in the Future.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, NOVEMBER 8.

ROYAL SOCIETY, at 4.30.—Prof. S. B. Schryver and E. J. Candlin: Investigations on the Cell Wall Substances of Plants, etc.—S. Dickinson: Experiments on the Physiology and Genetics of the Smut Fungi.—Isabella Gordon: Some Further Studies in the Development of the Skeleton in Echinoderms.—Ruth Deanesly: A Study of the Adrenal Cortex in the Mouse and its Relation to the Gonads.—Prof. W. J. Dakin: (*a*) Anatomy and Phylogeny of Spondylus, with a Particular Reference to the Lamellibranch Nervous System; (*b*) The Eyes of Pecten, Spondylus, Amussium, and Allied Lamellibranchs, with a Short Discussion on their Evolution.—Prof. C. E. Walker: Artefacts as a Guide to the Chemistry of the Cell.—Prof. F. F. Blackman and P. Parija: Analytic Studies in Plant Respiration. I.—P. Parija: Analytic Studies in Plant Respiration. II. The Respiration of Apples in Nitrogen and its Relation to Respiration in Air.—Prof. F. F. Blackman: Analytic Studies in Plant Respiration. III. Formulation of a Catalytic System for the Respiration of Apples and its Relation to Oxygen.—Prof. R. R. Gates and F. M. L. Sheffield: Chromosome Linkage in certain Œnothera Hybrids.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. G. H. Hardy: Prolegomena to a Chapter on Inequalities (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Balneology Section), at 5.—Dr. G. L. K. Pringle: Presidential Address.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. F. Still: The History of Pediatrics to the End of the 16th Century (FitzPatrick Lectures) (II.).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. H. Fagge: Axial Rotation, Purposeful and Pathological (Bradshaw Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Capt. G. Pitt-Rivers: The Clash of Culture (II.). Culture-Clash in a Maori Village.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—P. C. Buck: Music and the Child-Mind.

INSTITUTION OF CIVIL ENGINEERS (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6.—A. E. Sadler: Modern Methods of Sewage Disposal.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W. B. Woodhouse: Overhead Electric Lines (Illustrated by a Cinematograph Film).

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Deptford Town Hall), at 6.—B. H. Knight: Granite Setts in and around London: Some Factors Affecting their Wear: Description of Micro-Structure of Granite Setts.—W. J. Pickering: Exhibition of Rock Cutting Methods.

INSTITUTION OF STRUCTURAL ENGINEERS, at 6.30.—Lieut.-Col. J. Mitchell Moncrieff: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.—F. P. Baynes: Lecture.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—J. S. Lilly: Notes on Installation and Maintenance Risks.

INSTITUTE OF METALS (London Local Section) (at Royal School of Mines), at 7.30.—Prof. W. E. Dalby: The Plastic Contour.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—T. Smith: (*a*) On Systems of Plane Reflecting Surfaces; (*b*) Reflecting Systems for Image Inversion.—Dr. L. C. Martin and T. C. Richards: The Relation between Field Illumination and the Optimum Visual Field for Observational Instruments.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 7.45.—Wing-Comdr. T. R. Cave-Brown-Cave: The Machinery Installation of 'R 101.'

ROYAL SOCIETY OF MEDICINE (Neurology Section) (Clinical Meeting at West End Hospital for Diseases of the Nervous System, Out-Patient Department, Welbeck Street), at 8.

FRIDAY, NOVEMBER 9.

FARADAY SOCIETY (at Royal Institution), at 3.30.—Sir Oliver Lodge: Some Debatable Problems in Physics (Spiers Memorial Lecture).

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—J. W. Madeley: Town Water Supply in India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. W. M. Smart: On the Frequency Distribution of Restricted Proper Motions.—M. A. Ellison: Micrometrical Measures of the Potsdam Double Stars, made with the 10-in Refractor of the Armagh Observatory.—K. Nakamura: Observation of Meteors from Skjellerup's Comet, 1927 *k*.—Prof. S. Chapman: The Electrical Conductivity of Stellar Matter.—Dr. W. J. S. Lockyer: A Wide Absorption Band in some *B*-type Stars.—W. M. H. Greaves and H. W. Newton: Magnetic Storms and Solar Activity, 1874–1927.—Prof. E. A. Milne: (*a*) The Theoretical Contours of Absorption Lines in Stellar Atmospheres; (*b*) Ionisation in Stellar Atmospheres: Generalised Saha Formulæ: Maximum Intensities and the Determination of the Coefficient of Opacity.—Prof. S. Chapman: On the Radial Limitation of the Sun's Magnetic Field.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. M. C. Lance and others: Discussion on Loud Speakers.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Temperance Institute, Keighley), at 7.30.—C. H. Carter: Precise Length and Angular Measurement.

INSTITUTE OF METALS (Sheffield Local Section) (in Applied Science Department, Sheffield University), at 7.30.—Prof. F. C. Thompson: Flow in Metal Shaping Processes.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—B. Campbell: Nitrocellulose Finishes.

SATURDAY, NOVEMBER 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. T. E. R. Phillips: Recent Observations and Discoveries respecting the Planets (II.).

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (at Glasgow).—Dr. A. McCance and J. Jefferson: Steel Castings.

PHYSIOLOGICAL SOCIETY (at London Hospital Medical College).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 2.

UNIVERSITY COLLEGE, at 5.30.—Dr. J. S. Owens: Smoke Pollution of the Air and Public Health. (Further Lectures on Nov. 9 and 14.)

SATURDAY, NOVEMBER 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. W. Edwards: A Naturalist Trip to the Southern Andes.

TUESDAY, NOVEMBER 6.

WESTFIELD COLLEGE, at 5.15.—Prof. Charles Grant Robertson: The Ma[p] of Europe. (Succeeding Lecture on Nov. 20.)

KING'S COLLEGE, at 5.30.—Prof. A. Cock: Baron von Hügel.

WEDNESDAY, NOVEMBER 7.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. T. F. Cotton: Diseases o[f] the Heart and Blood Vessels in relation to Industrial Occupations.

KING'S COLLEGE, at 5.30.—Dr. F. A. P. Aveling: The Indebtedness o[f] Industry to Pure Science: The Human Factor.

SCHOOL OF ORIENTAL STUDIES, at 5.30.—Prof. A. Meillet: Les origines du vocabulaire européen. (Succeeding Lectures on Nov. 8 and 9.)

UNIVERSITY OF LEEDS, at 8.—Lieut.-Comdr. R. T. Gould: The Greatest o[f] all Navigators—Captain Cook.

THURSDAY, NOVEMBER 8.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. J. G. Robertson: The Spirit of Travel in European Literature in the 17th and 18th Centuries.

UNIVERSITY COLLEGE, at 5.30.—W. N. Weech: Roman Remains in Northern Africa.

FRIDAY, NOVEMBER 9.

UNIVERSITY COLLEGE, at 5.30.—W. L. Cook: The British Coal Industry.

SATURDAY, NOVEMBER 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Swiss Scene and Flowers.

CONGRESSES.

NOVEMBER 8.

SOCIOLOGICAL SOCIETY, LEPLAY HOUSE, AND TOURS ASSOCIATION (at London Day Training College).

At 10.30 A.M.—Reports on the Work done during the past Year by Leplay House Sociological Society and Leplay House Tours Association.

At 11.15 A.M.—Social Studies in Majorca.—Miss M. Maplesden: Geology and Flora in Majorca.—G. Morris: Some Notes on Swedish Lapland.

At 2.30.—C. C. Fagg: Some Results of the Croydon Survey.

At 4.45.—A. Farquharson, and Group Leaders from the Tours Students "Camp," 1928: Field Studies at St. Peter.

NOVEMBER 19–24.

Liquefaction of Coal, Low Temperature Distillation, High Temp[erature] Distillation, Power from Coal, Coal Tars, and Oils, Complete G[asifica]tion of Coal, Origin of Coal, Coal Washing, Pulverised Coal, Catalysts and the general aspects of the Bituminous Coal Industry.

SATURDAY, NOVEMBER 10, 1928.

CONTENTS.

The Position of Scientific and Technical Officers in the Civil Service.

ON various occasions during the past few years claims have been made on behalf of professionally qualified scientific and technical workers in the Home Civil Service for improved salaries and other conditions of employment. It has been pointed out that the qualifications normally demanded by the State as a condition of appointment to junior scientific and technical posts imply that candidates for them must have had just as long a training and attained at least as high a level of intellectual attainment as candidates for junior administrative posts. It is asserted also that the burden of responsibility of such officers on behalf of the State is probably greater than that of their corresponding numbers on the administrative side of the service. On these grounds alone it is contended that their general conditions of service should be at least equal with those of the administrative classes. Furthermore, it is denied that a high degree of specialisation and outstanding specialised knowledge of science necessarily unfits a man for the assumption of the highest administrative office. If, therefore, the State wishes its service to possess the utmost attractiveness to men of outstanding scientific ability, it should either put an end to the existing disparity between the initial pay and prospects of its scientific and its administrative officers in their respective spheres, or give more favourable consideration to the claims of its specialist officers for the highest posts in the administration.

Most of these points were made by leading men of science in their evidence in 1913 and 1914 before the Royal Commission on the Civil Service, but the intervention of the War prevented due consideration being given to them at the time. After the War a new body was constituted, the Civil Service National Whitley Council, the general objects of which were "to secure the greatest measure of co-operation between the State in its capacity of employer, and the general body of Civil Servants in matters affecting the Civil Service, with a view to increased efficiency in the public service combined with the well-being of those employed; to provide machinery for dealing with grievances, and generally to bring together the experience and different points of view of representatives of the administrative, clerical, and manipulative Civil Service." Apparently professional civil servants were included in these categories, for the Institution of Professional Civil Servants, all the members of which are

professionally qualified, the Society of Civil Servants, and the Civil Service Confederation, both of which embrace a number of professional men, were given representation of the staff side of the Council.

At the second meeting of this National Council it was decided to consider the reorganisation of the Civil Service in the light of the recommendations of the Royal Commission. The clerical classes were first reviewed, and a report on the duties, method of recruitment, and scales of salary of the clerical, executive, and administrative grades was issued early in 1920. Immediately after this report was issued, the Chancellor of the Exchequer appointed a Committee consisting of the late Lord Asquith, Lord Colwyn and Lord Maclay to consider "the question of the remuneration which should attach to the principal posts in the Civil Service as exemplified by a Permanent Under Secretaryship of State." This Committee recommended that the basic salaries of these officers, most of whom had been in receipt of £2000 a year, should be raised to £3000 a year. This recommendation was put into immediate effect. Without suggesting that these classes were too generously dealt with, it is undoubtedly a fact that their salaries were considerably improved.

Unfortunately, the National Council did not proceed at once to deal with the professional classes in the same comprehensive way. These were left for the time being to a Treasury Committee, to be considered piecemeal, and then only in a few departments. One or two departments were dealt with fairly generously. The British Museum staffs, for example, were given a salary scale of £250 to £800 for the entry grade, subject to an efficiency bar at £540. In striking contrast, this range of salary covered five different grades among the scientific staffs at the National Physical Laboratory, promotion from one grade to another depending on the occurrence of vacancies. Eventually the official side of the National Council consented to the appointment of three special sub-committees to deal with certain grades of professionally qualified persons. This was in 1922. By that time the post-War boom in trade had given place to trade depression, and financial stringency had produced the 'Geddes Committee' with its so-called economy proposals. In this atmosphere the staff side representatives on the three sub-committees had to conduct their negotiations with the representatives appointed by H.M. Treasury. To make matters worse, during these negotiations the Government appointed a Committee under the chairmanship of Sir Alan Anderson "to inquire into the standard of remuneration and other conditions of employment of the various classes of State Servants employed in the Civil Service," and this Committee expressed itself thus:

"It has been represented to us on behalf of this [the professional] group, that the pay of Professional men in the Civil Service has not been increased as much as the pay of administrative grades, and that it will not in the future attract candidates of the right quality. . . . We do not share this view, nor do we agree that there is any direct relation between the pay of the Administrative Officer and the Professional men who advise him as occasion arises. We have already said what we think about the former; the latter should, in our judgment, relate his pay and position with those of his professional brethren in the outside world. . . . As the present scales of pay attract good candidates to-day we see no reason for an increase."

This pronouncement reflected the view of the Treasury, so that it is not surprising that the results of the negotiations on behalf of the scientific and technical staffs were disappointing in the extreme. Even the plea that junior scientific assistants should be given established posts on entry to the service and confirmed in them within a two years' probationary period was dismissed, although in the Reorganisation Report on the Clerical Classes the National Council had already stated:

"We have found ourselves in entire agreement with the views expressed by the Royal Commission of the Civil Service regarding the evil effects of employing temporary clerical staff on permanent work. Our intention is that all classes proposed by us should be employed on a permanent and pensionable footing."

Considering the nature of the duties of junior scientific officers, particularly their access to, and participation in, work of a highly confidential character, one might be justified in assuming that the principle laid down for clerical classes applied with far greater force to them. The fact remains that there are still large numbers of professionally qualified scientific officers employed in a temporary capacity in various Government departments, although the work upon which they are engaged is permanent in character.

The sequel to this treatment of professional civil servants is illuminating. On Oct. 8 the *Times* published an article from its Civil Service Correspondent dealing with the failure of certain departments to attract men with the necessary scientific and technical qualifications to fill appointments in the Civil Service. Before the War, for example, an ample supply of candidates for assistant examinerships in the Patent Office was available. In 1910 no fewer than 157 candidates presented themselves for nine appointments. To-day, conditions are

entirely changed. An examination has just been held for six appointments, but only thirteen candidates presented themselves, out of which number six were already in the Civil Service. It is also established that the superior attractions of outside employment open to men with scientific qualifications is resulting in a loss to the service of men who started their careers in the Civil Service. The Patent Office has lost quite a number of men in this way; during the present year four members of the examining staff have resigned to take up industrial occupations. The peculiar knowledge required in the course of their official duties enhances the examiners' usefulness for the purposes of certain industrial firms, and there is a danger here, as in the United States, that the Patent Office may become a training ground for men who look to industry for their ultimate careers.

Such a result might have been foreseen. The growing complexity of industrial processes adds to the difficulty of establishing an indisputable right to a patent. It behoves industrialists, therefore, to employ the keenest intellects in this particular branch of their work, and it is an obvious economy to pay well for such service. Yet the basic scale of salary of Patent Office assistant examiners is the pre-War scale. The State has neither exercised any foresight in this matter nor has it paid any attention, apparently, to the condition of affairs which arose out of similar circumstances in the United States. In a report submitted in 1920 to Congress dealing with the classification of government officials and the salaries and conditions of service attached to the various classes, emphasis was laid on the increasing difficulty experienced by the United States Government in connexion with the recruitment and retention of professional civil servants. As an example it cited its Patent Office. "As a result of the excessive turnover of staff it has almost ceased functioning."

Other departments in our Civil Service are even worse off than the Patent Office. In spite of the improvement in the commencing salary of cartographers in the Hydrographic Department of the Admiralty, the greatest difficulty has arisen in inducing candidates to come forward. Even greater difficulty has been experienced in recruiting properly qualified persons as assistant surveyors in the Admiralty and Air Ministry. In both these departments there are vacancies which cannot be filled although the required standard of professional competence has been lowered. The demand for well-trained intellects by industrial firms is a comparatively new phenomenon in Great Britain. It is rapidly becoming more marked. Already the State is finding that some of its keenest younger professional workers are transferring their abilities to big industrial combines, where, rightly or wrongly, they imagine they will be given greater scope. The question arises, Will the State fail to deal adequately with the problems arising out of the employment of its professional Civil Servants until, for this class, State service becomes a last refuge? This is what happened in the United States when the big industrialists realised the importance of employing highly qualified professional men and women in their undertakings.

We suggest that a general inquiry into the scope of duties, the scales of salary, and other conditions of employment of all professionally qualified Civil Servants is long overdue. We suggest further, that such an inquiry, including as it must consideration of the relations between professionally qualified and other Civil Servants, should be conducted by those who are entirely removed from any suspicion of bias. We certainly do not consider that the Civil Service National Whitley Council, as it is at present constituted, is capable of undertaking this task. The need would best be met by the appointment of a Royal Commission to consider specifically the problems arising out of the comparatively recent growth within the Civil Service of a large class of workers to which the traditional Civil Service system has still to be attuned.

Magic and Medicine.

From Magic to Science: Essays on the Scientific Twilight. By Charles Singer. Pp. xix + 253 + 47 plates. (London: Ernest Benn, Ltd., 1928.) 25*s*. net.

DR. CHARLES SINGER is well known as one of the very few students in England who pursue the subject of the history of medicine in a critical and scientific spirit. He is well equipped for the work by his knowledge of the classical languages and Hebrew, as well as by his inquiring spirit. He is, too, greatly helped by his wife—Mrs. Dorothea Singer—who has recently published the first volume of a catalogue of Latin and vernacular alchemical manuscripts in Great Britain and Ireland, dating from before the sixteenth century. Nevertheless, we welcome Dr. Singer's volume "From Magic to Science" with somewhat mingled feelings, of pleasure in the first place, because it is very interesting; of regret, that he should have spent so much valuable time in re-editing and adding to a series of essays which

have been published in various readily accessible periodicals. There is still much to be done in tracing the decline in the observational sciences from the intellectual efficiency of classical antiquity to the recovery which began in the twelfth and thirteenth centuries. We grudge every moment that Dr. Singer spends in retracing his steps.

The book contains eight essays on various subjects, and the title "From Magic to Science" applies strictly only to the fourth, entitled "Early English Magic and Medicine." Dr. Singer shows in this essay how Greek medicine in a debased form became known in Europe through Latin translations before the Arabian revival, and so formed the groundwork of early English medicine. The knowledge thus transmitted was scanty enough, but was perhaps more accurate than that obtained a little later when the original Greek had passed through Arabic, which itself was translated into Latin, both versions being frequently made by persons who had an imperfect knowledge of Arabic and no knowledge of the subject with which they were dealing. It is not surprising, therefore, that many of the original Arabic words are still in use. The earlier stage is represented by the charms and spells which are written in corrupt Greek, but not in Greek characters. Dr. Singer shows that the loss of scientific knowledge was gradual, and reached its lowest depth about the end of the fourth century. After this there was a long period of ignorance until the revival began in England in the middle of the thirteenth century with the advent of Robert Grosseteste and the recovery of the works of Aristotle, even though the translations were so bad that Roger Bacon wished they were all burnt.

The essay on the Lorica of Gildas of Britain is written primarily for scholars, as the subject is difficult and somewhat barren. A Lorica is a breastplate or hauberk, and the word was employed metaphorically in the sixth century to mean a prayer the recital of which protected from the devils who, in medieval imagination, were constantly thrusting against the breastplate of good deeds and Christian observance. The Lorica ascribed to St. Patrick expressly states that it is a hymn made for the protection of himself and his monks against the enemies that lay in ambush for the clerics. "When any person shall recite it daily with pious meditation on God, demons shall not dare to face him, it shall be a protection to him against all poison and envy; it shall be a guard to him against sudden death; it shall be a Lorica for his soul after his decease." The interest of the Lorica of Gildas lies in the language in which it is written—a characteristic form of Latin known as 'Hisperic' or 'Hibernian' which was used, Dr. Singer says, in south-west Britain and Ireland in the sixth and seventh centuries. Anglo-Saxon copies of the Lorica were made, but the language was so unintelligible that glosses had to be freely supplied.

There is an excellent chapter on herbals, in which Dr. Singer directs attention to the fact that palæolithic man left few drawings of plants in comparison with the number of animals he depicted; the explanation offered being that the paintings were of a magical character to bring animals into the power of the hunter, whilst plants required no hunting. He also points out that the herbals originated in the south of Europe, for the pictures nearly always represent southern species. The Bury St. Edmunds Herbal, written about 1120, is an exception, for its author was a lover of the plants he saw around him.

Dr. Singer's views on the visions of Hildegard of Bingen are well known. The drawings illustrating the Scivias, one of her great mystical works, were produced under her personal direction and are in colour. They show undoubtedly that she suffered from attacks of typical migraine with teichopsia. The condition is now well known; it is very painful, it incapacitates during the attacks, but has no effect on longevity. Hildegard herself was born in 1098 and lived until 1179 or 1180.

There is a final essay on the school of Salerno and its legends.

The book is well illustrated throughout, and the coloured plates, often copied from manuscript herbals, are especially pleasing. The date of the birth of Dr. William Harvey is incorrectly given on page 65, but the mistake is not repeated on page 108 where it is correct.

The Quantum Theory.

Die neuere Entwicklung der Quantentheorie. Von Prof. Dr. A. Landé. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, Band 5.) Pp. xi + 180. (Dresden und Leipzig: Theodor Steinkopff, 1926.) 12 gold marks.

THE rapid advances in recent years in the various fields of physics make it increasingly difficult for the physicist to keep abreast of the remarkable developments in his subject, and for other men of science to keep in touch with current physical ideas. A series of publications such as the "Wissenschaftliche Forschungsberichte" thus serves a

valuable purpose in presenting in relatively short compass an authoritative statement of the present position in one or another branch of knowledge. By assuming the reader's familiarity with the elements of his subject, an author is enabled to give width and depth to his treatment, the result being a volume which is useful both to the advanced student and to the research worker. In the present case the editor of this series of monographs has been particularly fortunate in securing the services of a physicist who is noted alike for his eminence in the subject dealt with, and for his ability to write in a clear and attractive manner. The earlier edition of the book was familiar to most earnest students of the quantum theory, and the appearance of a second edition four years later gave the author the opportunity of thoroughly revising it, whereby prominence was given to the question of the nature of radiation. Moreover, a full list of the relevant references to the literature is included.

In the first chapter the quantum theory of radiation is treated in paragraphs dealing with light-quanta, statistics of light-quanta, radiation by matter, the stationary quantum states, the correspondence principle, and virtual radiation. The spectroscopic aspects of the theory are presented in the following two chapters on systems with one electron, and systems with several electrons, and adequate space is devoted to the consideration of multiplets, a topic to which the author himself has contributed extensively, and in a manner which is in large measure responsible for later theoretical developments, already foreshadowed in the present volume. Succeeding chapters are concerned with the magneton, band spectra, and molecule formation, the quantum theory of aggregate states, including Einstein's theory of gases, the mathematical methods of quantisation, and applications to the hydrogen atom.

In his concluding paragraph Landé enters wholeheartedly into the spirit of the new quantum mechanics initiated by Heisenberg, Born, and Jordan whilst the book was in preparation. Classical mechanics required Newton's calculus of fluxions; the general theory of relativity required Riemann's covariant tensor analysis; and the quantum theory likewise calls for the application of special mathematical methods for its complete elucidation. Much has already been accomplished in this direction, and we shall look forward eagerly to the early appearance of the third edition of this delightful book, where we may confidently expect to find the new quantum theory expounded in the author's inimitable way.

The Water Supply of Towns.

The Water Supply of Towns and the Construction of Waterworks: a Practical Treatise for the Use of Engineers and Students of Engineering. By W. K. Burton. Fourth edition, in 2 volumes, by J. E. Dumbleton. Vol. 1: *Collection and Purification Works.* Pp. xvi + 137 + 31 plates. 25*s.* net. Vol. 2: *Works for Distribution.* Pp. xv + 160 + 10 plates. 25*s.* net. (London: Crosby Lockwood and Son, 1928.)

THE appearance of the fourth edition of a technical work is unmistakable evidence that it has met with an appreciable degree of acceptance and that it has established itself in the estimation of professional circles. Mr. Burton's treatise on the water supply of towns, recently reissued in two new volumes under the editorship of Mr. Dumbleton, is thoroughly deserving of the reputation which it has gained, and clearly will continue to act in the future as a trustworthy preceptor for the student, as well as a serviceable reference book for the practitioner.

The scope of the work is fairly wide, though it will be admitted that in a number of respects it is far from exhaustive. Mr. Burton, who was at one time professor of engineering in the Imperial University of Tokyo and held a government post in Japan, wrote, not unnaturally, with an eye to the special needs of the country in which he lived and practised. This is evident from the series of remarks to be found here and there, usually in the form of footnotes, which are intended for the enlightenment and instruction of the Japanese student. The incidence of earthquakes, and the influence on the purity of supply of such special forms of culture as ricefields, are two notable examples of factors which do not affect water supply practice in Great Britain. Prof. Milne's short monograph on the special precautions to be adopted in earthquake countries, which forms the first of two appendices at the end of vol. 2, is full of much practical knowledge and competent advice.

Mr. Dumbleton has rightly respected the authority and experience of Mr. Burton, and while embodying the results of modern progress and research, has endeavoured to maintain unimpaired the general character of the original work. The alterations which have been made in the present edition mainly concern the purification of water, water softening, rapid filtration and pumping plant, in regard to which advances of a striking character have been made in recent years.

In a work which covers so many and varied

aspects (chemical, topographical, engineering, and statistical) of the subject of water supply, within the relatively modest compass of 297 pages, it is obvious that in places the treatment will inevitably be slight and general. The design of dams could in itself furnish matter for a good-sized book, such as Wegmann's well-known treatise, to which the author himself directs attention. In the chapter on the flow of water in pipes and channels, there is a reference to a formula of Eytelwein's, but no cognisance is taken of several other equally authoritative formulæ, all originating in the basic equation of Chézy, notably Gangouillet and Kutter's classic expansion, which is in quite common use, and generally held to be one of the most exact. However, for the purposes of a general review of the subject, the treatment is reasonably adequate and the book does not profess to be encyclopædic. The student will find fuller information as he widens his reading.

Under the heading of quantity of water required per head of population, the author, while mentioning the remarkable consumption (or should it be waste ?) recorded in certain American towns, states that 30 gallons per head per day is a very ample mean supply. Most engineers will agree, but there has been observed of late years an upward tendency which is worthy of note. Perhaps the increasing popularity of the motor-car has something to do with it, since cars are responsible for the use of a good deal of water for such purposes as washing down, and the number of vehicles now so treated is much greater than it was a generation ago.

In discussing reinforced concrete, the author states that the stress in the steel (presumably in pure tension) should be limited to 12,000 lb. per square inch. This is a somewhat low value, and in view of modern developments in the manufacture of steel, it may be exceeded by at least 25 per cent without incurring undue risk. The London County Council regulations permit a working stress of 16,000 lb. per square inch. Curiously enough, the author does not specify any limiting compressive stress for concrete.

It would be unfair, however, to allow such minor points to outweigh the general impression of excellence in the work as a whole. The two volumes are well printed and the production is entirely creditable to the publishers. There is a large number of diagrams, all very clearly and excellently reproduced. A somewhat unusual feature is the inclusion at the end of each volume of numerous trade advertisements by firms specialising in appliances connected with water supply. We do not know how far such a practice is to be understood to convey the approval and recommendation of the author concerned in respect of the advertiser's announcements, but it suggests a question of some interest to readers. BRYSSON CUNNINGHAM.

Insect Societies.

The Social Insects : their Origin and Evolution. By Prof. William Morton Wheeler. (International Library of Psychology, Philosophy, and Scientific Method.) Pp. xviii + 378 + 48 plates. (London : Kegan Paul and Co., Ltd. ; New York : Harcourt, Brace and Co., Inc., 1928.) 21*s*. net.

THIS book is a publication in English form of the course of twelve lectures delivered in 1925 by Prof. Wheeler at the University of Paris. The treatment here given of the evolution of the social insects—wasps, bees, ants, and termites—is as careful and thorough as would be expected of so eminent an authority.

It is obvious that in each of these various groups their peculiar structure and habits are closely interconnected, and their evolution is fully dealt with by the author from both points of view. The termites he considers to have arisen from among the Protoblattoids, possibly as early as the Permian : their evolution having been mainly conditioned by the diet of cellulose and the use of symbiotic protozoa. The Aculeate Hymenoptera, deriving their origin from unknown Phytophaga through primitive Terebrants and Bethyloids, have similarly been influenced in their development by the character of the food and by the specialisation of the female sex. It is interesting, as Prof. Wheeler remarks, that "essentially the same type of social organisation and behaviour has been independently attained by at least a dozen different groups of insects."

The author considers the possibility of comparing the societies of insects with those of man, and in the first place he notices the question as to whether societies composed of individuals are comparable with the individual organism considered as a colony of cells. He is willing to admit that such a comparison is legitimate, and he holds further that insect societies constitute an intermediate stage between the solitary metazoon and the societies of man. The evident distinction between a community of free individuals where each member expects advantages in excess of his personal inconveniences, and an association of cells reduced to the mere constituents of a whole the life of which is their sole object, does not of course escape his attention. From some rather uncalled-for remarks

on civilised society, we gather that Prof. Wheeler would not be unfavourably disposed towards the adoption of certain ruthless methods of social adjustment employed by the lower animals.

Dealing with the reproductive activity of insect colonies, the author remarks that the Aculeate societies are frankly female, the male being reduced to a merely temporary fecundative agency. The development of castes and polymorphism has followed as a direct consequence of the extreme preponderance of the reproductive function. In regard to the formation of castes, such terms as degeneration are misapplied; the peculiar traits exhibited by the queens, workers, soldiers, etc., are more appropriately recognised as specialisations. It is nevertheless true that the social habit does to some extent lead to regressive behaviour. Thus the worker honey-bee dies in a few hours if isolated from the colony, and the same dependence on its fellows, though to a less degree, has been observed in the worker ant. In theory, communal life should lead to a degeneration of its constituents if this would further the interests of the society as a whole; but it may be doubted whether the author's comparison of Achilles or Hector with Foch and Pershing, not exactly to the advantage of the latter, will bear critical investigation. It is also questionable whether his anticipation of the eventual disappearance of all solitary organisms, not domesticated by man, before the assaults of their socially organised enemies, is likely to be justified by the event. But whatever value may be attached to the author's speculations, there can be no question of the interest and importance of his book as a whole, or of the excellence of the illustrations with which it is plentifully furnished. F. A. D.

Our Bookshelf.

The Theory and Practice of Radiology: with a Synopsis of Radiography and Radiotherapy. A treatise in 4 volumes. By Bernard J. Leggett. Vol. 1: *Electrical Theory Applied to Radiology.* Pp. xii + 238 + 21 plates. 18*s.* net. Vol. 2: *The Physics and Measurement of X-Radiation.* Pp. xi + 308 + 56 plates. 25*s.* net. Vol. 3: *X-Ray Apparatus and Technology.* Pp. xi + 550 + 144 plates. 42*s.* net. (London: Chapman and Hall, Ltd., 1928.)

THE author has set himself a big task and, so far as may be judged from the three volumes which have been published, he has succeeded in doing it extremely well. Volume 1 is a book of 238 pages devoted to electrical theory applied to radiology, the various chapters including the dielectric, electric and magnetic circuits, varying currents, electromagnetic machinery, and the electron theory.

Volume 2 consists of 308 pages devoted to the physics and measurement of X-radiation. Here are found chapters on the origin of X-rays, X-ray spectroscopy, the properties of X-rays, the measurement of quality and intensity of X-rays, and one on protective methods in the use of the rays.

Volume 3 consists of 550 pages dealing with X-ray apparatus and technology. The scope of this volume may be inferred from the following chapter contents: the production of high vacua, the technique of X-ray tubes, the methods used for generating high potential electrical energy; the remainder of the volume, apart from appendices, being devoted to a description of screening stands and couches, accessory diagnostic apparatus, and the general lay-out of radiological departments.

From the foregoing it will be seen that the author has aimed at providing radiologists with a combination of theory and technical information. He is evidently familiar with the subjects on which he writes. He interprets the word radiology as the study of X-rays to the exclusion of other forms of radiation, such as ultra-violet, beta, and gamma radiation used by radiologists, for only very brief mention of these is made. There appear to be singularly few mistakes in the text; μ is, however, found above instead of below the line in Coulomb's expression.

Hitherto English readers have, we believe, not enjoyed anything like such a comprehensive work, and although no expression of opinion on the work as a whole is possible until the completion of Vol. 4, there is no doubt that, as it stands, it will be of the greatest service to radiologists. The publishers have done their part of the work well; the letterpress is excellent and the diagrams, including many half-tone reproductions, are well reproduced. S. RUSS.

A Guide to the Constellations. By Prof. Samuel G. Barton and Prof. Wm. H. Barton, Jr. (McGraw-Hill Astronomical Series.) Pp. x + 74. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 12*s.* 6*d.* net.

THIS atlas is compiled for the benefit of those who, with Carlyle, require someone to "teach me the constellations, and make me at home in the starry heavens." It is quite elementary, being devoted exclusively to naked-eye observational astronomy, and achieves its simple purpose more successfully than could be done in a popular text-book or more detailed atlas such as Norton's.

The principal charts are twelve in number, representing the sky as seen in latitude 40° at 9 P.M. during each month of the year. An unusual feature of these charts is the allowance for effects of atmospheric absorption on the magnitudes of stars at different altitudes, thus giving a more accurate representation of actual conditions. Only stars of magnitude 4·5 or brighter (after correcting for altitude) are entered. Some additional charts are also given, showing circles of right ascension and declination and constellation boundaries.

The letterpress is devoted mainly to explanation

of the charts and to such relevant astronomical information as should interest those wishing to use them intelligently. The information is concise and mainly accurate, though a slip appears to have been made in the paragraph concerning the apparent magnitudes of planets (p. 16), where Saturn is said to be always fainter than some of the bright stars, and Aldebaran is "ever brighter than Saturn." Useful descriptive notes are given of the constellations and of naked-eye objects visible therein. The usual table is also supplied whereby the most suitable chart may be chosen for any hour of the night.

Beginners wishing to familiarise themselves with the constellations should find this book useful, though expensive, and are given suggestions for further reading in a short bibliography.

An Introduction to Oceanography: with Special Reference to Geography and Geophysics. By Prof. James Johnstone. Second edition, completely revised. Pp. xi + 368. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd., 1928.) 15*s*. net.

IN this new edition the author has incorporated the outlines of many of the modern advances, particularly in geology and geophysics. The early chapters deal with the character and origin of the oceans, the depth and nature of the sea-bottom. The origin of the earth is first considered. This is done clearly and in an interesting way. The chapter on the chemistry of sea-water is disappointing. The account of phosphate and nitrate changes in the sea is very meagre. There are some rather unguarded statements. Hydrogen ion concentration is not determined by conductivity (p. 160); and the account of buffer action on the same page is incorrect. The warnings against taking routine observations of pH (pp. 161 and 200) are strange; much invaluable information is gained from them, both oceanographical and biological. On p. 314 g is not a force.

The importance assigned to de-nitrifying bacteria seems rather exaggerated in view of the work of Gran. Certainly they can scarcely be effective agents in carbonate precipitation (p. 85): photosynthesis is the most potent factor here. The last chapter of the book gives a good history of the geological changes the ocean has undergone. There are a few misprints: "Rhubidium" for rubidium (p. 131); "more" for "less" (p. 156, line 25); $1/10^{7}$ for $1/10^7$ on p. 160; Fig. 33B for Fig. 33A, paragraph 2, p. 187; 1·0025 for 1·025 (pp. 193 and 317).

There is a short guide to the literature, and a good index.

Die Geschichte unserer Pflanzennahrung von den Urzeiten bis zur Gegenwart. Von Prof. Dr. A. Maurizio. Pp. xx + 480. (Berlin: Paul Parey, 1927.) 32 gold marks.

THIS is a painstaking, erudite, and apparently exhaustive survey of the history of plant foods, their collection, harvest, and conversion from prehistoric times (as deciphered in the palæontological records) to the present day. The author makes the astonishing statement that in historical times, however much man may have improved plants serving as food, no plant fit for that purpose has been brought into general use that was not already known to prehistoric peoples.

The history is laboriously traced from a period prior to cultivation, when prehistoric man searched for and gathered the yield of wild plants, and an appendix lists more than 750 such plants exclusive of fungi. Later followed agriculture, from its simplest form to our present methods—from the simple pointed stick through the hoe to the plough. Chap. 11 of Part I. is of particular interest, for it deals with food-plant remains found in geological strata referred to the later stone and bronze ages —*i.e.* from 2000 to 800 B.C.—among which are recognisable the seeds of wild grasses that have remained unaltered, except under cultivation, to the present day. The earliest men must, of course, have eaten the food raw as collected, but later came the preparation of victuals by boiling, roasting, baking, and fermentation. It is pointed out that, though cultivation now has superseded collection almost entirely, yet the latter still goes on among aborigines and elsewhere in times of stress and also in specific instances nearly everywhere, as in the collection of edible fungi.

Contemporary Developments in Chemistry: Lectures delivered at Columbia University in the Special Course in Chemistry given in the Summer Session of 1926 on the occasion of the Opening of the Chandler Chemical Laboratories. Pp. vi + 30 + 13 + 26 + 20 + 20 + 16 + 28 + 20 + 17 + 21 + 8 + 14 + 16 + 12 + 24 + 20 + 14 + 15 + 10 + 19 + 29 + 17 + 22 + 17 + 16. (New York: Columbia University Press; London: Oxford University Press, 1927.) 55*s*. net.

THIS collection of lectures provides summaries of fairly recent progress in various branches of chemistry and is of a moderately advanced standard. It should therefore be of special service to those whose attention is of necessity confined to some particular field, but who wish to keep in touch with other branches of their subject.

The scope of the twenty-five sections is indicated by the following: Chemical reactivity, by J. F. Norris; crystal structure in its relation to chemical problems, by R. G. Wyckoff; immunology as a branch of chemistry, by H. Gideon Wells; radicals as chemical individuals, by C. A. Kraus; contact catalysis, by W. D. Bancroft; theory of velocity of ionic reactions, by J. N. Brönsted; reactions in liquid ammonia, by E. C. Franklin. It is scarcely necessary to point out that many of the sections are now somewhat out-of-date: this applies especially to that on the carbohydrates and to that on water-soluble vitamins. Most of the sections conclude with a useful list of references to original sources. It would be more convenient if the page numbering were continuous throughout the book.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fluorescence of Mercury Vapour under Low Excitation.

IN a letter published in NATURE of Aug. 18 under the above title, I described the excitation of mercury fluorescence using wave-lengths much longer than the resonance line λ2537, and even as long as λ3125. This fluorescence shows the well-known visual green with continuous spectrum. I have since found by photography that, at any rate when the vapour is dense, the spectrum shows, besides the visual maximum, the well-known broad maximum at about λ3300 in the ultra-violet. In this experiment excitation was by the iron arc, filtered by a bromine cell combined with vita glass, and the effective exciting wave-length is somewhere about λ3000.

It is important to determine whether the fluorescence thus excited by wave-lengths longer than the resonance line is of long duration—whether, in fact, it can be distilled away from the place of origin, as in Phillips's experiment with excitation by the core of the resonance line. I find, in fact, that such is the case. So far I have succeeded in carrying out this experiment with exciting wave-lengths up to about λ2650, but have not been able to get the effect with much longer waves owing to experimental difficulties. It is hoped to overcome these and to carry the matter further. In the meantime it seems fairly clear that, contrary to views that have often been held, the long duration does not depend on anything that happens only in the immediate neighbourhood of the resonance level of the mercury atom.

RAYLEIGH.

Terling Place, Chelmsford,
Oct. 29.

Higher Hydrocarbons from Methane.

THE importance of the formation of condensation products by thermal decomposition of methane is of interest to chemists and petroleum technologists alike, the latter being confronted with the problem of the better utilisation of 'dry' natural gas. The pyrolysis of ethane, propane, and the higher paraffins to form aromatic hydrocarbons is a well-established fact, while methane has not been found to show similar tendencies to any appreciable extent.

Several recent patents claim very high conversion yields of methane into ethylene, etc., but are still without published experimental verification. Fischer (*Brenn. Chem.*, **9**, 309; 1928) has shown that under conditions of high gas speeds, and hence short heating periods, with temperatures above 1000° C., the use of active catalytic material being avoided, methane can be made to fall into line with its homologues in yielding higher hydrocarobns, although the yield is very poor.

The formation of small amounts of acetylene has been recorded by Bone and Coward (*J.C.S.*, **93**, 1197; 1908), and also by Fischer (loc. cit.), and it is of interest to know to what extent this gas occurs in the gaseous products of reaction.

As the result of work which has been carried out in this laboratory during the past year, we are in a position to confirm Fischer's recent claims, having used a purified methane gas throughout. This we have found to yield, on subjection to passage through a silica tube at 1100° C. (heating duration of 12 seconds), approximately 10 per cent of liquid and solid hydrocarbons (free from carbon black) calculated on the original methane, while, in other experiments, the gaseous products of the reaction contained 0·9 per cent of acetylene as well as olefines. Analysis of the acetylene, regenerated from its metallic derivatives, indicated that there was not an appreciable quantity of its higher homologues present (n in $C_nH_{2n-2} = 2{\cdot}03$).

It would appear impossible to decide at the moment the mechanism of this reaction. The condensation of molecule fragments 'CH,' 'CH_2,' and 'CH_3,' formed by loss of hydrogen, has been suggested by Bone and Coward and also by Fischer, and this theory is probably the correct one.

In a private communication from Prof. Aarts to one of us, a statement was made to the effect that a highly active form of carbon, prepared under special conditions, can combine with hydrogen to form liquid hydrocarbons at ordinary pressure. This has since become the subject of English Patent No. 278,745.

It would be interesting to know whether the carbon formed in this decomposition process, which we have always found in this reaction in increasing quantity, and probably of less activity, with decreasing gas rate, possesses, even temporarily in the nascent state, any such activity sufficient to form higher gaseous hydrocarbons.

This work fills a distinct gap in the recorded behaviour of pure methane on thermal decomposition, and opens up new fields for investigation.

H. M. STANLEY.
A. W. NASH.

Department of Oil Engineering and Refining,
University of Birmingham,
Oct. 30.

Long Wave Radio Reception and Atmospheric Ozone.

I THINK that it is desirable that I should add a note of warning to Mr. Sreenivasan's letter under the above title in NATURE of Oct. 27, as there are two or three points about the ozone values that would probably not be familiar to Mr. Sreenivasan, which make it doubtful whether the relation that he brings out is a real one.

First, the steady decrease in the ozone values during the period that he used is due to the regular annual variation of ozone which we have found every year in regions outside the tropics. It is always dangerous to assume a direct connexion between two quantities where the variations of at least one of them are chiefly due to an annual periodicity, and particularly where the two values show only a steady increase or decrease during the period under review.

Secondly, while our observations have not yet begun in India, the results that we have for other places of low latitude indicate that the annual variation of ozone in these latitudes is very small and the values are very constant all through the year (the monsoon conditions in India may make the ozone variations somewhat abnormal there).

Finally, we have no evidence of any world-wide variations of the amount of ozone, and it appears that the values depend chiefly on the time of year and on the atmospheric conditions in the immediate vicinity. I should not, therefore, expect that there would be any appreciable connexion between the ozone values found in Europe and those found in India. For these reasons it is very desirable to have more confirmation before accepting the connexion between radio signals in India and the ozone values in Europe as a certainty.

It may well be that there is some connexion between ozone and radio reception where both are in the same locality—possibly similar to that between magnetic storms and radio reception—but at present we have not been able to obtain suitable radio data over a sufficiently long period to test this point.

G. M. B. DOBSON.

Robinwood,
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Diffraction of Cathode Rays by Calcite.

A MONOCHROMATIC beam of cathode rays was directed against a cleavage face of calcite at a grazing incidence, and the diffraction pattern was obtained on the photographic plate placed behind the crystal normal to the incident beam. The energy of cathode rays, which were generated in a gas tube worked by an induction coil, was about 50 kilo electron-volts, the wave-length of the corresponding material waves being about 0·055 A. In the photograph reproduced (Fig. 1) is shown one of the patterns, which was obtained when the incident beam was perpendicular to [110] axis of the crystal and made an angle of 6° with the cleavage face. The photographic plate was placed 6·4 cm. away from the crystal. As will be seen, the pattern consists of a number of bands of different

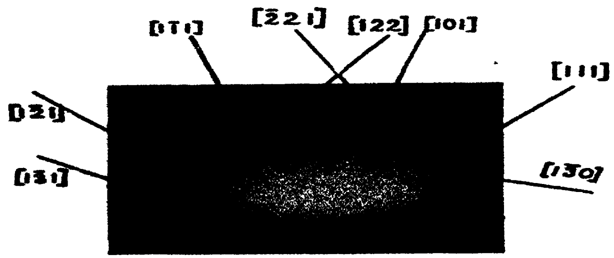

FIG. 1.

widths (for example, [111] in the figure), and also many black and white lines (*e.g.* [13̄0] in the figure), 'black' and 'white' being referred to the negative. It resembles the pattern which is produced when the cathode rays are transmitted through a mica sheet of certain thickness (S. Kikuchi, *Proc. Imp. Acad. Japan*, **4**, 271, 275, 354; 1928). Usually a black line makes a pair with a white line parallel to it. When the distance between the lines becomes small, the pair looks like a band. In fact, one edge of a band is bounded by a black line and the other edge by a white. There is no doubt that the band is nothing but a pair of lines separated by a short distance. Moreover, some of the bands show satellites which may be regarded as other pairs of black and white lines parallel to the main bands (for example, [13̄1] in the figure, though difficult to recognise in the reproduction).

As for the mode of formation of the pattern, a similar interpretation may apply as that already given for the pattern of the fourth type (loc. cit.); namely, if electrons could penetrate into the crystal, undergoing a multiple scattering without an appreciable loss of energy, then the electrons scattered by the crystal atoms will form divergent rays emerging from a point source in the crystal itself. These are regularly reflected by the net planes in the crystal according to the Bragg condition, and the cones of reflected rays thus formed intersecting with the photographic plate should give rise to the black lines, while at the same time white or absorption lines will be produced by the loss of the rays that are reflected. This happens when the intensities of the rays reflected from the two sides of the plane are not equal. Since the probability of scattering through large angles is smaller than that through small angles, white lines should appear nearer to the central spot than the corresponding black line. This is actually proved to be the case. When the net plane is just parallel to the incident beam, it may be expected that the lines should disappear owing to the compensating effect due to the reflection from both sides of the plane. Even in this case, however, there appears still a sort of band, of which both the edges have the same structure.

Corresponding to each pair of black and white lines or each band, we can find the net plane in the crystal that produces it. The intersection of the plane with the photographic plate falls midway between the black and white lines of a pair. The intersections are shown in the figure by the lines prolonged outside of the picture, and the indices of the planes are given in square brackets. The distance between the black and white lines calculated on the above assumption from the wave-length used and the spacing of the corresponding net planes is in good accord with that observed. The satellites of the band can also be explained as due to the reflection of higher orders. Relative intensities of such lines due to different orders show a close similarity with those of X-ray reflection of the corresponding orders. This seems to show an important fact, that the structure factor for X-ray reflection has a similar influence on cathode ray reflection.

The above method would be more useful than the transmission method on account of its possibility of extensive application on many crystals. Besides calcite, cleavage faces of mica, topaz, and zinc blende and a natural face of quartz were tried, and it was found that they also give similar patterns. In some cases, besides these lines above described, spots similar to Laue's were observed on the plates. When the photographic plates were placed on the lateral side of the incident beam, some lines were also observed which must have been produced by the electrons deflected through an angle greater than 90°. When the initial energy of the electrons is less than about 15 kilo electron-volts the patterns were no longer obtainable.

SHOJI NISHIKAWA.
SEISHI KIKUCHI.

Institute of Physical and Chemical Research,
Tokyo, Sept. 17.

Changes in the Form of Mammalian Red Cells due to the Presence of a Coverglass.

IN 1924, Gough described a remarkable change in the form of mammalian red cells which can be observed in suspensions of these cells in isotonic saline (Gough, A., *Biochemical Journal*, **18**, 202; 1924). The normally discoidal cells become perfect spheres, the volume of which can be shown to be the same as that of the discoidal forms. It has hitherto been believed that it is the immersion of the cells in saline which produces this change of form. This, however, is not the case, as the following experiments show.

(1) A suspension of washed human red cells in isotonic saline (0·85 per cent sodium chloride) is prepared. If the cells are examined in a drop without being covered with a coverglass, they show the typical discoidal form with biconcavities. Often a little crenation is present. If the same drop is covered with a No. 0 coverglass in such a way that only a thin layer of fluid is left between the coverglass and the

slide, the cells become perfectly spherical. The distance between the slide and the coverglass is about 10 μ; the diameter of the spherical cells is about 5 μ, and so the cells move about freely between the glass surfaces. If the coverglass is removed and the fluid beneath it examined in a moist chamber, it will be observed that the cells slowly reassume the discoidal form. First they show fine crenations, but remain roughly spherical; afterwards they suddenly become discoidal, the disc usually showing some irregularity of contour. The reassumption of the discoidal form does not occur with the same constancy as does the assumption of the spherical form, and usually takes several minutes. The change from the discoidal to the spherical form is almost instantaneous.

(2) That the change of form is largely dependent on the distance between the coverglass and the slide can be shown in the following way. A No. 0 coverglass, 24 mm. × 50 mm., is supported on a slide to one end of which is cemented a small glass strip about 1 mm. thick. A wedge-shaped chamber is thus formed, which can be filled with the cell suspension. Examination of the end of the chamber at which the slide and coverglass are widely separated shows that the cells are discoidal, while at the narrow end of the wedge, where the distance between the glass surfaces is small, they are perfect spheres. At an intermediate position they are extremely crenated, the crenated form being apparently intermediate between the discoidal and the spherical form. After some time crenation may appear even in the deep end of the chamber, and a few spherical forms may be seen.

(3) The pressure of the coverglass plays no important part in the production of the phenomenon, as may be shown by turning the stage of the microscope at right angles to the table.

(4) If a drop of a suspension of red cells is placed at the edge of a coverglass, the cells in the drop will be seen to be discoidal. As the cells are carried under the coverglass by the flow of the fluid, they become spherical. After some time, sufficient fluid may pass under the coverglass to raise it considerably from the slide (under which conditions the coverglass will slip off the slide if the latter is tilted vertically); the cells passing between the glass surfaces are now discoidal.

These and other similar experiments indicate that the assumption of the spherical form of the cell is dependent on its being in close proximity to two closely opposed glass surfaces. The nature of the surfaces may vary; for example, both slide and coverglass may be paraffined. It is impossible to avoid the conclusion that a force, capable of bringing about a distortion of the cell, exists between the surfaces, and it is possible that this force is related to the molecular fields which exist between two closely applied plates separated by a fluid. Further experiments will show whether or not this explanation is adequate. If it proves to be so, or, indeed, if any such force is shown to exist in general between two opposed glass surfaces, the fact is worthy of the attention of cytologists and of others working with similar preparations.

It should be mentioned that the change of form is not shown by red cells suspended in serum, plasma, hæmoglobin solution, or solutions of many other surface active substances. It occurs, however, in isotonic citrate, in Locke's solution, and in other balanced saline solutions, and in the case of all mammalian red cells which have been examined.

ERIC PONDER.

The University, New York,
and the New York Zoological Society.

Series Limits.

IN a recent letter to NATURE (April 21, 1928, p. 619), I gave evidence that there exist cases of spectral series which undoubtedly depart from the predictions of Hund's theory of the limits of component series. Hund's predictions have been used extensively by many workers in the field of atomic spectra, and have led them frequently into error in dealing with spectra with inverted terms. The question is one of fundamental importance in the dynamics of the atom.

In my previous letter I stated that I had been able to find no flaw in Hund's argument which could lead to any change of the predictions. Recently, however, working from the known cases of the failure of the theory, I have been able to detect a step which renders his whole argument invalid.

The error lies in a failure to realise that a strong magnetic field, in the usual sense, may still be a weak field from other points of view. Actually, the ordinary strong field produces the Paschen-Back effect of each multiple term, but leaves terms of different L and S still separate, that is, the $(L\,S)$ coupling is broken down, and the J's disappear, but the $(l_1\,l_2)$ and $(s_1\,s_2)$ couplings remain intact. Hund compares the atom in such a field with the limit term plus electron in a field so large that all the vectors $l_i\,s_i$ are quantised independently along the field, that is, even the $(l_1\,l_2)$ and $(s_1\,s_2)$ couplings are broken down. Obviously, the two magnetic fields are of different orders of magnitude.

Consider a particular example, the ${}^3P\,{}^1P$ built on a ${}^2P$ by the addition of an s-electron. In the ordinary Paschen-Back field, the ${}^1P_1$ is characterised by the pairs of magnetic quantum numbers $m_l\,m_s$ (1, 0; 0, 0; − 1, 0), whereas in the larger field the corresponding pairs are (0, 1; − 1, 1; − 1, 0), regardless of whether the system is an inverted one or not. If the ${}^2P$ limit is regular, (${}^2P_{\frac{1}{2}}$ lower) those characteristic $m_l\,m_s$ pairs of ${}^1P_1$ can only be built from the ${}^2P_{\frac{3}{2}}$ part of the limit; and, if the ${}^2P$ is inverted, they can only be built from the ${}^2P_{\frac{1}{2}}$. The latter case will serve to illustrate.

${}^2P_{\frac{1}{2}}$.		S-electron.		Resultant.		
m_l	m_s	m_l	m_s	m_L	m_S	
0	$\frac{1}{2}$	0	$\pm\frac{1}{2}$	0	1	${}^1P_1$
− 1	$\frac{1}{2}$			0	0	${}^3P_0$
				− 1	1	${}^1P_1$
				− 1	0	${}^1P_1$

This leads to agreement with the empirical data for inverted terms.

In dealing with such cases of the addition of an s-electron to a limit term, the usual rule must be used; that, as the magnetic field increases, sub-levels of the same m must not cross. This rule is sufficient to give correct results for both regular and inverted terms in all the known cases of an s-electron, including ${}^3P\,{}^1P$ on ${}^2P$; ${}^3D\,{}^1D$ on ${}^2D$; ${}^4D\,{}^2D$ on ${}^3D$; ${}^4F$ and ${}^2F$ on ${}^3F$. But when one applies the rule to the more complicated cases where the series electron is a p or d electron, it is found that the various levels of any actual case may or may not give a co-ordination between the separate ion levels and the series levels. That means that the non-crossing rule cannot be rigidly adhered to. In other words, we do not know how to find the 'super' Paschen-Back effect for the whole set of terms belonging to such an electron configuration. Since the order in which the increasing magnetic field breaks down the various vector couplings determines the final result, it will probably be impossible to find any general rule to cover all cases.

It is a matter of coincidence that Hund's theory gives the correct result for the simplest non-inverted

cases. It is not to be expected that his predictions will agree with fact in any case involving a p or d series electron either for regular or inverted terms.

A. G. SHENSTONE.

Palmer Physical Laboratory,
Princeton University,
Princeton, New Jersey.

The Invention of the Hot Blast in Iron-Smelting.

PROF. BONE's claim for Neilson of the invention of the hot blast cannot be allowed to pass unchallenged, for the regenerative principle of heating and cooling fluids had been patented by the Rev. Robert Stirling in 1816. After stating how he proposed to apply this principle in general terms, the inventor proceeds to describe his first modification, which was to be applied "to diminishing the consumption of fuel in glasshouse and other furnaces wherever a high degree of heat is required." Stirling's Scottish specification figured as an anticipation in the Neilson trials, but Stirling refused to appear as a witness against Neilson. The English specification was first printed in the *Engineer* for Dec. 14, 1917. I shall be pleased to send a copy of the reprint of this article to any person who applies to me.

E. WYNDHAM HULME.

37 East Street, Littlehampton.

HAVING read Mr. E. Wyndham Hulme's letter, together with a copy of the article in the *Engineer* to which he refers, and the specification of Stirling's Patent No. 4081 of 1816, I cannot see any ground for his supposition that it anticipated Neilson's subsequent invention of hot blast in iron-smelting. Stirling's specification describes and claims what is usually termed the 'regenerative' principle in furnaces, whereby heat from outgoing hot products of combustion is transferred to an inflowing air draught; and there is not a single word in it referring to the use of hot blast in iron-smelting. The central idea of Neilson's invention as applied to iron-smelting was that the use of an air blast preheated by combustion of small coal on a separate grate *outside* the blast furnace would save many times as much fuel *inside* it, which, paradoxical though it may and certainly then did seem, is nevertheless true; it is obviously different, and never could have been forecasted, from the principle of heat regeneration or recuperation. It was, indeed, one of those flashes of inspiration which sometimes come to a man of genius and through him revolutionise human affairs. In applying his idea at the Clyde Ironworks during the years 1829–32, when its success was so triumphantly demonstrated, Neilson did not use the regenerative principle at all, or indeed any means of preheating the blast described or foreshadowed in the Stirling patent; nor did he use any hot gases or products from the furnace for this purpose. The Stirling patent may be held to have anticipated Siemens' later inventions, but certainly not Neilson's process.

Moreover, when one remembers that in 1842–43 the validity of Neilson's patent was vindicated after two most fiercely contested actions at law in both the English and Scottish Courts, during which the Stirling patent was cited and fully examined, it seems presumptuous of Mr. Wyndham Hulme to ask us now to reverse the decision then arrived at in the Courts. His attempt to *dim* the lustre of Neilson's great achievement by *raking up* the embers of a past controversy which, after most exhaustive and searching inquiries, was decided in Neilson's favour at least two generations ago in the most decisive manner possible, is to be strongly deprecated. As I said in my article, the scurvy treatment meted out to Neilson by the ironmasters of his day is perhaps one of the most disreputable chapters in the whole history of industry; fortunately, the law which he invoked gave him some material redress as well as a pronouncement in favour of the originality of his invention; and since that time the verdict of the law has become that of history also.

WILLIAM A. BONE.

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South Kensington, S.W.7.

The Dissociation of Pure Mercury.

WITH reference to Mr. Bradley's letter on the dissociation of pure mercury in NATURE of Oct. 13, p. 573, I do not think that experimental evidence on the conductivity of other dilute amalgams confirms his calculation of the number of electrons per cubic centimetre of mercury.

If the amalgam contains c atoms of X to 100 atoms mercury, and if p, q are the average numbers of free electrons per atom of X and of mercury respectively, then

$$n/n_0 = d/d_0(1 + pc/100q)/(1 + cM/(100 \times 200{\cdot}6)),$$

where d, d_0 are the densities of amalgam and mercury, and M is the atomic weight of X. For dilute amalgams the density may be calculated with sufficient accuracy on the assumption that there is no volume change on amalgamation, whence

$$n/n_0 = (1 + pc/100q)/\left(1 + \frac{M}{200{\cdot}6} \cdot \frac{c}{100} \cdot \frac{d_0}{d_x}\right),$$

where d_x is the density of X. Hence the conductivity should be given by

$$\sigma/\sigma_0 = 1 + 2/3\frac{c}{100}\left(p/q - \frac{M}{200{\cdot}6}\frac{d_0}{d_x}\right) - 1/9\left(\frac{c}{100}\right)^2 \left((p/q)^2 - \frac{M}{200{\cdot}6} \cdot \frac{d_0}{d_x} - 5\left(\frac{M}{200{\cdot}6} \cdot \frac{d_0}{d_x}\right)^2\right).$$

By comparing the coefficients of c and c^2 with the empirical values, p/q may be estimated. In the case of cadmium amalgams at 14° C., the conductivities of which are represented by a quadratic formula, the agreement between the values of p/q calculated from the 2nd and 3rd terms of this formula is striking. Allowing for the fact that concentrations in E. J. Williams' paper (*Phil. Mag.*, **50**, 599; 1925) are given in parts of cadmium per part of *amalgam*, I find the formula $\sigma/\sigma_0 = 1 + 0{\cdot}0437c - 0{\cdot}000873\ c^2$, whence the calculated values of p/q are 7·44 and 7·46 respectively. This excellent agreement appears, however, to be fortuitous. The following table gives values of p/q calculated from the measurements of Williams (*l.c.*), Edwards (*Phil. Mag.*, **2**, 1; 1926), and Johns and E. J. Evans (*Phil. Mag.*, **5**, 271; 1928). In all cases where only one value of p/q is given, the experimental results are represented accurately by a linear formula, and the value of p/q that would be given by equating the coefficient of the quadratic term above to zero is very different from that obtained from the linear term.

In	7·24, 3·40	Ce (300°)	10·0	
Mg	10·2, 6·81	Ga (300°)	9·02	
Tl	4·22, (1·23)	Cu (300°)	10·2	
Tl (100°)	4·53	Cd (100°)	7·70	7·55
Ge (300°)	7·92	Ag (15°)	6·69	
Sb (300°)	11·1	Ag (100°)	8·63	
Y (300°)	9·16	Ag (300°)	14·5	7·98

The conductivity of amalgams is probably far too complex a phenomenon for any such simple relation as that given above to be applicable to every case.

E. S. KEEPING.

University College of Swansea,
Oct. 19.

Algæ in Sodium Phosphate Solutions.

WHILE working in chemical laboratories I have often noticed a green colour in the sodium phosphate bottles which did not occur in any other bottle. On examination under the microscope this proves to be due to the presence of unicellular green algæ, either singly or in chains. I should be glad if any biologist would give me any particulars of this plant, and the reason why it prefers sodium phosphate bottles to, say, sodium nitrate.

W. R. TROTTER.

School House, Sherborne.

ONE of the algæ which occurs in sodium phosphate bottles is apparently a *Chlorella*, possessing a prominent pyrenoid, cells 3-5 μ in diameter, from each of which four daughter cells may arise. Mr. W. R. Trotter's reference to cells in chains suggests that he may be dealing with a different species, a *Palmella* or a palmelloid state, for example. The *Chlorella* rather resembles a starved form of *C. pyrenoidosis* Chick, but the latter was described as growing in sewage effluents, rich in available nitrogen. Nevertheless, Dr. Chick (*Proc. Roy. Soc.*, 71, 458; 1903) found that it would grow in solutions containing only ammonium salts, potassium phosphate, and sodium carbonate, and its mineral requirements were thus very low. Algæ growing in sodium phosphate solutions must similarly be able to grow on mere traces of the essential mineral elements. It is of interest to note that *Chlorella*, according to Hopkins and Wann, is one of the few plants which can grow without calcium.

The presence of such plants in sodium phosphate solutions and their absence from solutions of other sodium salts is probably an extreme illustration of a general tendency among the smaller green algæ to prefer dilute culture solutions in which phosphates are abundant or in excess. Calcium salts, and particularly nitrates, on the other hand, favour the development of small diatoms. So far as is known, however, diatoms are never obtained in culture by inoculation from the air, although green algæ may at times be obtained from this source. The diatoms have usually a higher salt requirement also, which equally will prevent their growth in solutions nominally of one salt.

W. H. PEARSALL.

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Oils, Greases, and High Vacua.

IN the course of some work (which I hope shortly to publish) on the evaporative distillation of petroleum derivatives, I became aware of the possibility and advantages of using oil in place of mercury as working fluid in condensation pumps. I was distilling lubricating oil in an apparatus similar in principle to that used by Brönsted and Hevesy to separate the isotopes of mercury. The saturation pressure of the oil vapour could be deduced from the observed rate of distillation and the estimated molecular weight of the oil: in a particular case the saturation pressure was about one dyne/cm.² at 118° C., that is, about the same as the saturation pressure of mercury at room temperature. No decomposition could be detected. Clearly, if this oil could be heated until its vapour pressure was, say, 100 dynes/cm.², without decomposition, it could be used as working fluid in a condensation pump and might be expected to give a performance, without artificial cooling, comparable with the performance of a mercury condensation pump with a cold trap 100° C. below room temperature. I therefore prepared by fractionation a quantity of this oil and evacuated ionisation gauges (large and small thermionic valves), on oil condensation pumps. I have been unable to measure the lower limit of pressure reached by these pumps. 10^{-3} dynes/cm.² has been reached without ovening the glasswork: when the glass was ovened, the ionisation current could not be detected with the instruments available—the pressure probably did not exceed 10^{-4} dynes/cm.².

Not all oils can be distilled to dryness in the evaporative still. Decomposition usually begins at 320-340° C. I was able to prepare a grease with a vapour pressure of not exceeding 1 dyne/cm.² at 320° C. (as deduced from distilling speed): this grease was used to lubricate the ground joint between the ionisation gauge and the pump in the above experiments. Mr. J. D. Cockcroft, at the Cavendish Laboratory, found the vapour pressure of this grease to be less than 10^{-3} dynes/cm.² at 70° C. As was to be expected, it was too small to be detected by the evaporation method used. Joints made with this grease may in fact be employed freely, even at temperatures as high as 70° C. (This substance is not a 'grease' in the sense used by the oil technologist, *i.e.* it does not contain a soap, but is simply a petroleum jelly residue.)

It has been customary to regard with grave suspicion the introduction of oil or grease into systems in which high vacua are to be produced. This attitude represents a generalisation which must now be subject to many reservations.

C. R. BURCH.

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Rayleigh's 'Radium Clock.'

TWO years ago a 'radium clock' was constructed for the Chicago Radium Institute similar to the original one described by Strutt (*Phil. Mag.*, 1903). Three milligrams of radium sulphate, contained in a thin-walled glass tube, was used as the activating source. A platinum wire sealed into the tube made metallic connexion with the gold leaf support. The containing tube was of pyrex glass and was fitted with a ground joint at the top to allow the removal and adjustment of the parts. A carefully cleaned glass rod was sealed into the upper half of the ground joint which served as a support for the source and gold leaves and provided sufficient insulation for the operation of the clock. A chemical deposit of silver made the inner walls of the tube conducting, with the exception of a small opening left for observation. Due to this silver coating, the tube was not baked out but was exhausted with mercury diffusion pumps.

At the lowest attainable vacuum (less than 10^{-5} mm. of mercury) the period of the clock was about 29 seconds, but after twenty-four hours would increase appreciably, due to the accumulation of gas from the walls of the tube. After several days' pumping the tube was sealed and set up under a bell jar. The ground joint at the top was carefully sealed with red sealing-wax. After several days the period of the clock increased from 29 seconds to 43 seconds, indicating either a leak or a slow emission of gas from the walls of the tube. However, the period remained approximately constant at 43 seconds for several months and was assumed to be in equilibrium. Small changes in period were noted, apparently due to changes in room temperature.

No observations were made of the period of the clock for more than a year, when it was noted that the period had decreased and now has a value of 34 seconds. Since any leakage of air into the tube would increase the period of the clock, it was thought that perhaps some 'clean up' action due to the β- and γ-rays was taking place within the tube. It scarcely seems possible that any changes in the gold leaves

could account for this much change in the period. There would be some increase in charge on the walls, but this would be practically equalised each time the leaves discharge in contact with the case. Whatever the explanation may be, the observed fact was thought to be of sufficient interest to put on record.

J. S. Thompson.

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Chicago, Ill.

Processes of Colour Photography.

Owing to the fact that my article on "Processes of Colour Photography" (Nature, Nov. 3, p. 687) was written some months ago, and to the fact that progress in this branch has suddenly become rapid, some of my statements are already out-of-date.

The commercial production of another 'tripack,' which it is also intended to market as a triple roll film, has just been announced by a new firm called Colour Snapshots, Ltd., as distinct from Colour Photographs, Ltd. It is reported that these latest packs will be available to the public within a month or two, and should prove of very considerable interest, since they are based on entirely novel principles which have previously been considered impossible. However, examples which I have seen are very promising, and there is little doubt that they will prove a great success.

The novelty is that the red sensitive film or blue printer negative is placed in the front, then the green sensitive, and finally the blue sensitive or yellow printer at the back of the pack, that is, farthest from the lens. This order fits in exactly with the requirements of any printing process, since the blue image, which gives the 'drawing' of the picture, is critically sharp.

With this pack filters of only very low factor are required, and emulsions of high sensitivity can be used so that a very rapid combination can be produced, at least as fast as the average roll film. With the more normal type of pack discussed in my article, only relatively low speeds are obtainable with the types of emulsions at present available.

When it has definitely been proved possible to take a set of three colour separation negatives which even approximate to theoretical accuracy with an instantaneous exposure, then an enormous field will have been opened up, not only for amateur snapshot work in colour, but its effects are also likely to be felt very soon in the world of colour printing and illustration and in colour kinematography.

F. J. Tritton.

32 Lawn Crescent,
Kew Gardens, Nov. 5.

Habitats of Araucarias and Changes of Climate.

In *Science News-Letter*, Feb. 18, 1928, referred to in Nature of Aug. 18, p. 257, the statement is made, on the authority of Dr. R. W. Chaney, that "the living Araucaria species all prefer cool, rather dry habitats." This statement was the main reason given for the conclusion that the Gobi region of Manchuria *had a dry, rather cool climate in the* Cretaceous period when the dominant trees were Araucarias.

In a letter to Dr. Chaney I pointed out that the two species indigenous in Australia, *A. Cunninghamii* and *A. Bidwillii*, occur in tropical or subtropical latitudes in regions of heavy rainfall, and that other species of the genus occur in New Caledonia and Norfolk Island, which can scarcely be described as cool and rather dry.

In reply, Dr. Chaney has written: "I find that I stated that the present-day habitat of Araucaria was in cool dry regions, a statement which should have been qualified to apply to the more common species of South America. Such errors are particularly misleading in connexion with palæo-ecology, and I greatly regret being responsible for this one."

W. B. Alexander.

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Post-War International Scientific Meetings in Germany.

In the "News and Views" columns of Nature of Oct. 20 reference is made to the annual autumn meeting of the Institute of Metals planned for September 1929 at Düsseldorf as "the first occasion that any British scientific society has held a meeting in Germany since 1914."

On the occasion of the joint meeting of the Society of Glass Technology and the Deutsche Glastechnische Gesellschaft at Aachen in May last, attended by some 450 persons, our German colleagues, some of whom are prominently connected with other German scientific societies, stated publicly, and with considerable pride, that the meeting of the two glass technology societies was the first fully representative international meeting of two scientific societies to be held in Germany since the War.

The experience of our Society at this meeting was such as to lead us to believe that any other British scientific organisation arranging to meet in Germany can look forward to pleasant and fruitful results.

W. E. S. Turner.

(Hon. Secretary, Society of Glass Technology.)
The University, Sheffield.

The Unit of Velocity.

It is only by some such device as that suggested in Sir Oliver Lodge's letter in Nature of Oct. 13, p. 573, that the Stroud system of units can take its place in a rational scheme of mechanics.

Multiplication and division are primarily operations with numbers; in algebra we write $2x \times 3x = 6x^2$, where x denotes a number. We may, however, in certain cases give a conventional meaning to the result of multiplying symbols which denote physical quantities; thus, if (a) denotes the unit of length, we may take the product $2(a) \times 3(a) = 6(a)^2$, provided we interpret $(a)^2$ as denoting the unit of area.

So in mechanics we may divide distance by time and take the quotient 6 ft. ÷ 2 sec. = 3 ft./sec., provided we interpret ft./sec. as being the unit of velocity. We cannot, however, do this unless velocity be regarded as a fundamental concept, for the unit of which it is advisable to have some such name as is suggested.

V. Naylor.

11 Lyndhurst Road,
Plymouth.

Continued Self-pollination in Cotton.

In Nature of Sept. 1, 1928, p. 314, Mr. G. L. Kottur distinguishes between "the deterioration of a selection due to selfing" and "the hybrid vigour of the F_1 plants." Surely, on whatever theory we interpret hybrid vigour, both phenomena are manifestations of it. To attribute to hybrid vigour the greater yield of a variety over its pure line selected for yield is therefore illogical if it is maintained that there is no reduction in vigour on selfing.

J. B. Hutchinson.
(Assistant Geneticist.)

Empire Cotton Growing Corporation,
Cotton Research Station, Trinidad,
Sept. 25.

Problems of the Ocean.[1]

THE International Permanent Council for the Exploration of the Sea has issued, as a jubilee volume, a record of all that the contributors think most worthy in the performance of their respective thirteen nations during a quarter of a century of international exploration of the sea. It is thus not only a record of national accomplishment and co-operation, but also an up-to-date epitome of oceanography with the highest authority. He who will know the latest views as to the movements of the Atlantic may read Otto Pettersson on the Gulf Stream and E. Le Danois on the seasonal *va-et-vient* of Atlantic waters, while Everdingen recounts the Dutch observations on the velocity of currents in the North Sea. Of nitrifying and de-nitrifying bacteria and the variation of phosphate and nitrate content, K. Brandt gives a brief but clear account; salinity and its relation to freezing, alkalinity and its relation to carbonic acid, are expounded in an attractive essay by W. E. Ringer: Gran considers the response of the plankton to all these varying conditions, and Ostenfeld its geographical variation (see also the obituary notice of Cleve), with consideration of the extent to which herrings select from it or feed omnivorously. Hjort's souvenir of s.s. *Michael Sars* is a compendium of the salient facts as to drifting of spawn and the good and bad years of fish production, and the latter question can be followed further in the short summaries by Borley of Miss Thursby-Pelham's work, and by A. C. Johansen of the investigations of Johansen and Kirstine Smith. The general reader, the general biologist, the geographer, and the legislator will find here, in 270 pages of fairly easy reading, the cream of a generation's hard work on the problems of the ocean.

Most instructive of all, and rightly made prominent, is the well-known story of the eel. In 1904, on the Danish research ship *Thor*, Schmidt discovered a single glassy, fish-shaped larva of the common eel, in mid-Atlantic, west of the Faroe islands, lat. 61° 21′, long. 10° 59′. With what patience and success Dr. Schmidt followed up that discovery, and the fascinating story of migration which he revealed from the English or Danish mill-dam to the Caribbean Sea, and from the Caribbean Sea to the Danish or English mill-dam—this is now knowledge spread through the world. From that single larva discovered by the *Thor* has resulted not only the romantic life-history of the common eel with its intense biological interest, but also light on the movements of Atlantic waters, a considerable piece of evidence as to the theory of continents, and a thriving industry of eel-culture in Germany (with a base on the Severn) estimated by H. Lübbert to have produced already more than 2000 tons of valuable food worth upwards of £200,000. So little is it possible to foresee what will be the actual results of systematic research, or of scientific curiosity and skill. Similarly John Murray showed that, from his examination of one sample of rock from Christmas Island, the British Treasury received in royalties on phosphates and consequent taxes considerably more than the total cost of the *Challenger* Expedition.

Sir John Murray's portrait greets us on p. 15 of the "In Memoriam"; in which obituaries to the colleagues who have passed are prefixed to the national contributions. Preceding the obituaries are the *Procès-Verbaux* of the Conferences, and the book opens with a page of preface by the able president of the International Council, Mr. H. G. Maurice. Each national contribution contains the summarised history of that nation's entrance into the work. France begins with Belon and Rondelet, Scotland with Edward Forbes, and Ireland with Turton, but England follows the more rigid rule adopted by Germany and Denmark, and deals with nothing that happened before 1899. Yet, without calling in Ray, or even Couch, we must go earlier than 1899 to appreciate the English narrative, and must consider how it came to pass that in 1902, as Mr. Borley truly says, "The complex of investigations constituting the sea work was delegated to the Marine Biological Association of the United Kingdom, under the direction of Dr. E. J. Allen. It was thus placed in hands of proved competence."

The history of English fishery research may be said to begin with the International Fisheries Exhibition at South Kensington in 1883, when Huxley's inaugural address startled the unlearned among his countrymen. "Once in a year, an acre of good land carefully tilled, produces a ton of corn, or two or three hundredweight of meat and cheese. The same area at the bottom of the sea yields a greater weight of food to the persevering fisherman every week of the year." Edward Forbes, a generation earlier, had used eloquence and reason in vain, but with the Prince of Wales and the Duke of Edinburgh to help, and with a charming open-air café where all London made its summer evening parties in the new electric light—at length Huxley, Avebury, and Lankester, aided by Spencer Walpole, Norman, and many others, attained success. For the first time some hundreds of the English people were convinced that they who rule the waves and feed from them may profitably attempt to understand them.

With Huxley as president, the Marine Biological Association of the United Kingdom was formed in March 1884, and while the iron was hot Lankester took up the task of making the Association a reality. It was a heavy task, but it is pleasant to know that Sir Ray Lankester sees now the great outcome from those labours of forty-five years ago. He collected nearly £10,000 from more than a hundred donors (besides annual subscriptions) and the Treasury gave a grant of £5000: from these funds £12,000 was spent in building and fitting the Laboratory, finished in June 1888. By 1890 the income, though precarious, exceeded £1200 a year, including £120 from annual subscribers, £500 from the Treasury, and £400 from the Fishmongers' Company. This

[1] "Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-Verbaux des Réunions." Vol. 47: Rapport Jubilaire (1902–1927). Pp. iv + 274. (Copenhague: Andr. Fred. Høst et Fils, 1928.) n.p.

last was in addition to a princely gift of £2000 towards the initial expenses.

The young biologist, hunting for a post, will be interested now to read page x of the first volume (N.S.) of the Association's *Journal*, issued at the end of 1890. "The Resident Director . . . receives £200 a year and a residence. A naturalist has also been appointed at a salary of £250 a year, whose duties are confined to the study of food-fishes, and provision has been made for an assistant to the Director. These are the only salaried officers of the Association." Yet the pioneer-work done by Cunningham, Heape, Garstang, Weldon, G. C. Bourne, Fowler, Allen, Holt, Todd, and many others was of the greatest value. They each laid their labour on the foundations of Huxley and Lankester, and so helped in enabling their Association, after eighteen years, to be equal to the responsibility of the North Sea investigations.

There were many who helped; for, thirty and forty years ago, three out of four of British zoologists did what they could for the Plymouth Station. But two especial notes must be made. The Worshipful Company of Fishmongers has aided the Association from its beginning with capital, with annual income, with moral support and countenance, and with hard work on the governing Council. It is not too much to say that without the Company's enlightened generosity and kindness there would have been no body in England in 1902 fit to undertake the English share in the North Sea investigations. The other essential element in the history of English marine biology has been the thirty-three years' directorship of E. J. Allen. Four able men, carefully chosen, preceded him in that position, each helping, each creating; but it was from Dr. E. J. Allen's advent that the difficult and halting advance of the Laboratory became a steady progress. Income increased very slowly, but the work done with it increased incredibly, alike in volume, in variety, and in co-ordination. To the scientific eminence and administrative ability of the Director is due the fact that the nearly deserted laboratory of 1893 was able in 1902 to organise with success the North Sea investigation, and that in 1928 it is the focus of biology in England.

The North Sea investigation was entrusted to the Marine Biological Association against the bitter opposition of the Department of Fisheries in the Board of Trade. There was, of course, the perfectly legitimate desire to improve the status of the Department by increasing its revenue, but there was also an old standing quarrel which need only be lightly touched here, though many developments may be read at large in blue-books (*e.g.* Cd. 4304, pp. 290-291 and *passim*; 1908). The trouble was characteristic of the relations between science and Government officials in the nineteenth century, and we may perhaps see signs of the first chapter of its genesis in a letter of Huxley's ("Life," vol. 2, p. 243):

"The *idée fixe* of the British public, fishermen, M.P.'s, and ignorant persons generally is that all small fish, if you do not catch them, grow up into big fish. They cannot be got to understand that the wholesale destruction of the immature is the necessary part of the general order of things."

The chief fisheries official of the Board of Trade took the view here ascribed to the British public: the naturalist of the Marine Biological Association arrived at the conclusion which had been reached by Huxley. The naturalist, being called upon to give evidence before a Parliamentary Committee, said what he thought; the chief official said that this was a departure from discipline; because the Bill had been prepared by the Department, and since the Association received some Government money it must be considered as belonging to the Department; therefore the naturalist should not have given evidence disagreeing with that of his superior official and with a Departmental doctrine of biology. Until the official's retirement, nine or ten years later, this anti-departmental evidence was never forgiven either to the naturalist or to the Association.

However, the Treasury offered the North Sea investigation to the Association, with £1000 for initial expenses and £5500 a year to cover the hire and expenses of a research vessel at sea and of a laboratory on land as well as the salaries to the naturalists. Dr. Allen dared to face even this budget, and, in the event, its two ends were made to meet. This was mainly due to the self-sacrificing habit, among zoologists at that time, of undertaking any kind of biological work at the wages of manual labour. In the 'blue-book' already cited the salaries of biologists at Lowestoft were criticised for their extravagance by a representative of the Department:

7388 . . . "the work of the Association on these lines—this plaice work—has taken the whole time of one naturalist, supplemented to some extent by that of another, whose salary is £200 a year. . ."

7393-4 . . . "and for ourselves £156 for the salary of a biologist and £130 for material, a total of £286."

7395 "(Mr. Gardiner) What do you pay your biological assistant?" [Answer]—"£156 per annum, or £3 a week. It is only a weekly engagement; there is a liability to dismissal at any week."

Fortunately, the Ministry of Agriculture and Fisheries is not bound by the precedents of the Department of the Board of Trade, and Dr. E. S. Russell, in his able conduct of its investigations, is not content to pay £3 weekly wages for a cardinal piece of research. The Ministry, the Association, and independent biologists now work harmoniously in mutual assistance and profitable co-ordination, and Borley's historical account shows the excellent work which has been done in the North Sea both under the Association and under the Ministry (the main defect in his summary is that it scarcely mentions the important researches made by Mr. J. O. Borley). But the stigma of altruism clings to biologists, and in all branches of the Civil Service the first class man who is a biologist is still paid less than the second class man whose value is not depreciated by such knowledge.

What have we gained by these researches? We know the life-history of the plaice as the life-

history of no other wild animal is known in sea, air, or land. We are steadily compiling the life-history of other food-fishes. In 1902 the North Sea was an opaque grey mystery, in which the Admiralty had charted tidal streams and the Scottish Fishery Board had recorded unrelated surface-drift. In 1928 we know it a mosaic of moving blocks of water the individualities of which have been traced many hundreds of miles in their orderly processions. They are recorded, for the years of international observation, in progress up the Channel or round Scotland, along the 'broad Fourteens' or across by the Dogger, in movements as definite as those of spring Manitoban or American winter wheat, and with comparable economic significance. The vitamins that cure rickets and consumption have been followed from sunlit algæ, through protozoa, crustaceans, and small fish, to the cod which yields them to man. The unexpected history of phosphorus has been shown, with the vast unused hoards of the deep sea, stirred by beneficent storms until our herring are fed, twisted up by the Humboldt current so that the gulls of the South Pacific are able to make guano for English fields. In twenty other aspects of sea-life order now appears where a generation back we knew only curious detached facts and baffling anomalies. Best of all, perhaps, the research has yielded new discovery of curious detached facts and baffling anomalies, among which the labours of the next twenty-five years shall introduce new order, unlooked-for knowledge, and new material for the researches of generations to follow.

Of still wider interest is the achievement of these important results by team-work of united nations. In the continuance of this we are encouraged to look forward to further solution of scientific and economic problems which can be attacked successfully by no single nation. In the extension of such team-work may come regeneration of the world.

G. P. B.

The Fixation of Shifting or Blown Sand.

In the *Scottish Forestry Journal* (vol. 42, pt. i.) Mr. J. F. Annand discusses the progress of the planting work on Culbin Sands, Morayshire. In the *Annales de l'École Nationale des Eaux et Forêts (Nancy) et de la Station de recherches et expériences forestières* (Tome 2, Fascic. 1, 1928) Monsieur H. Perrin, of the French Forest Service, deals with the same subject in a monograph entitled "La Fixation des Dunes maritimes en France." Since the world's classic example of this type of work was commenced in France a century and a half ago, a brief résumé of the French methods will be first given. The chief area dealt with by M. Perrin (he mentions others of a lesser importance) is the region on the western coast of France between the mouths of the Loire and the Adour, a stretch of fine white sand some 400 kilometres in length extending along the shores of the Bay of Biscay, forming an almost uninterrupted chain of dunes; the most important area lies to the south of the Gironde in Gascony between the latter river and the Adour, a distance of 231 kilometres, with a breadth of from 3 to 7 kilometres.

In 1804, Brémontier estimated the total area of the sand dunes in France at 155,000 hectares, of which 120,000 hectares were in Gascony. It was in this latter area, which owing to its importance and the damage the sand was causing in its march inland by covering up valuable agricultural lands, where the first studies were made some century and a half ago in this matter.

Some controversy has taken place on the subject of the power of shifting sand to continue its advance and destruction indefinitely. Brémontier more than a century ago held that the sand dunes continued an implacable advance in the direction of the prevailing winds, submerging everything in their passage at a rate of 20 metres per year. Others now hold that the sand is unable to advance beyond a certain distance from the coast; that when the wind from the sea lessens in force the sand is either blown back by the land winds or the dunes become stabilised and eventually covered with vegetation. Examples of old dunes of this kind are said to exist in Gascony. Nevertheless it is an established fact that a century and a half ago villages, vineyards, and forests were being gravely menaced in this region by the advance of the shifting sand; and further, the mouths of the rivers were blocked by bars resulting in their waters being held up, large areas of unhealthy marshes being formed just inside the coast line. In fact, at the period when the treatment of the sand was first undertaken the whole locality was malarious and the scanty population wracked with fevers.

The work to be briefly described has completely changed the countryside, which now contains a forest of great pecuniary value covering some 600,000 hectares and affording employment to a large healthy and wealthy population; though it should be remembered that the work in its inception was purely protective. The vegetation of the dunes before treatment and fixation consists in Gascony of the following: *Psamma arenaria* (the commonest species), *Convolvulus soldanella*, *Eryngium maritimum*, *Ononis repens* var. *maritima*, *Cakile maritima*, *Euphorbia paralias*, *Galium maritimum*, *Linaria thymifolia*, *Silene Thorei*, etc. Partial stabilisation brings in *Carex arenaria*, *Helichrysum Stœchas* and *Aira canescens*. When some soil has commenced to form on the sand the following make their appearance—*Erica scoparia* and *cinerea*, *Salix repens*, *Cistus salviæfolius*; *Scirpus holoschœnus*, *Carex trinervis*. On old-established dunes the forest appears, consisting of *Pinus pinaster* (the maritime pine) and several oaks (*Quercus Ilex*, *Tozza*, *pedunculata*, and in the south *Q. Occidentalis* and *Suber* (cork oak), with as undergrowth *Polypodium vulgare*, *Pteris*

aquilina, *Osmunda Regalis*, and, occasionally, *Rubia peregrina*.

This association of plants is of interest, because at the outset in the newly created forests of *P. pinaster* only a thin soil covering of mosses and lichens exists as undergrowth, some of the above species only appearing with the improvement of the soil. It is for this reason that two leguminous plants were introduced with the young pine crops, namely, the broom, *Sarothamnus* (*Cytisus*) *scoparius* and *Ulex europaeus* (gorse).

One hundred and fifty years ago this region in Gascony afforded a scanty pasturage to a few troops of half wild cattle and horses. A few scattered areas had been sown up with the seed of *Pinus pinaster*, but the problem of stabilising the sand had not been solved. In 1774 the Abbot Desbiey presented to the Academy of Sciences at Bordeaux a monograph dealing with the fixation of the dunes, but it was not published and was lost. In 1779, Colonel Baron de Charleroix-Villers, Inspector of Fortifications and Works, drew up a memoir, which is now a classic, on the fixation of the dunes and draining of the marshes. His views were approved by the Government, but effect was not given to them. The method of approaching this work was by that time understood, and had been already applied in Holland and Denmark. It was Brémontier, Chief Engineer of Roads and Bridges, who secured the Government's acceptance of his proposals, on the lines of Charleroix-Villers, and started the work in 1787. Brémontier was associated with Peyjehan, a resin merchant who had already sown up some of the sand areas on his own account.

The work was successful from the outset, and it was continued until 1793, by which time 94 hectares had been sown. The work was then interrupted owing to the disturbances due to the French Revolution. It was restarted in 1801 under a 'Commission of the Dunes,' the work being divided between the Roads and Bridges and the Forest Departments. It was carried on in this fashion until 1862, when the business was placed entirely under the Forest Department. By 1864, so far as the fixation of the dunes and the protection thereby gained, the work was completed; 79,000 hectares (out of more than 100,000) had been stabilised and placed under forest at a total expenditure of 9,600,000 francs (122 francs per hectare, or about £2 per acre).

The success led to the recognition of the value of the recovered lands, and private proprietors took up the planting work and claimed some 21,000 hectares of the area which Government had thus brought under a valuable crop, claims which were admitted. What was commenced as a purely protective work has turned out a great financial success, the pine not only providing timber but also a resin which is more lucrative than the timber.

The work on the Culbin Sands in Morayshire will now be considered. These sands extend for about 4 miles along the coast of the Moray Firth. If Maviston Sand Hills, on the borders of the counties of Moray and Nairn, are included, the length of the coast line occupied is about 6 miles, and the breadth of the dunes varies from 1½ to 3 miles. Local tradition ascribes a sudden origin to the existing conditions, asserting that a large tract of once fertile land was overwhelmed and buried beneath the sand. Mr. Annand is probably correct in considering it as more probable that the process was a gradual one, going on more or less regularly or intermittently for centuries. It is, however, a historic fact that the final calamity took place in a great gale in January 1694, when the estate of Culbin, reputed so fertile as to be known as 'The Garden of Moray,' was invaded and overwhelmed in the great sand storm.

The Culbin area may be divided into three zones; (1) Towards the south or landward edge it is rather flat, with a sandy covering of moderate depth, intermingled with stretches of pebbly sand and small shallow marshes; (2) a middle zone consists of low sand dunes with partially fixed surface; (3) farthest to the north and seawards a series of high dunes rises to a height in some instances of 120 feet or more, the dunes being unstabilised and destitute of vegetation. Stretches of flat shingly ground occur also throughout most of the higher dune zone.

The flora of the Culbin sands has been studied by Patton and Stewart (*Trans. Bot. Soc. Edin.*, session lxxix, 1914–15). As is the case in France, the moving sand is fixed by planting marram grass (*Ammophila* [*Psamma*] *arenaria*). When the sand is partially fixed various grasses and weed growth gradually establish themselves, all tending to bind the surface and, says Annand, "ultimately make it fit for tree-planting. Weed seeds have also been sown to hasten the process." Hair grass (*Aira caryophyllea*), Brome grass (*Bromus* sp.) and Yorkshire Fog have been tried with considerable success. *Carex arenaria*, *Lotus corniculatus*, *Viola canina*, are amongst species which establish themselves naturally at the earlier stages of fixation. Thereafter *Calluna* and *Erica* are plants which come in and help to complete the process.

During the last century a considerable part of the ground on the landward zone had been reclaimed from the sands and planted with trees. During the War the greater part of this timber was felled and removed. The task of replanting this area—the Forestry Commission acquired the area in 1922—has proved comparatively easy, the only difficulty having been the draining of the flat marshy parts where the sand dunes had interfered with the natural drainage, a similar state of affairs to that formerly existing in Gascony. More than 1000 acres of ground, mainly of this description, have already been planted.

As regards the work in connexion with the fixation of the moving sands, it is being carried out on somewhat similar lines to the French methods. Space unfortunately precludes a detailed description here of the latter methods, which are now well known or can be readily ascertained by consulting the two monographs here dealt with.

The vital difference between the two is, however, that the French sow the tree seed *in situ*, whereas

at Culbin planting is resorted to. From the earliest French attempts as soon as the sand was sufficiently stablished, in other words on the landward areas where the sand was not in active movement, they sowed a mixture of the seed of the maritime pine with the two leguminous plants, the broom and *Ulex*, the two latter having proved indispensable in assuring the successful development of the young pine. This method has been in force for 150 years, and its success in the case of the sands in Gascony is beyond dispute; and it is cheap. The original species planted last century at Culbin was the Scots pine. Corsican pine appears now to offer prospects of heavier crops of timber, and is to be used extensively.

Whether the experiments so far carried out justify the change from the indigenous species is at least open to doubt; and the same applies to *Pinus contorta* var. *Murrayana*, also supposed to be a rapid timber producer. But all these species are planted. Mr. Annand writes, "The process of fixation of the moving sand is somewhat slow, and three to four years must usually elapse before tree planting can be safely commenced. The work already done, however, appears to provide sufficient evidence that the afforestation of even the most mobile of the dunes can be successfully accomplished." As a matter of fact, this latter problem has not been in doubt for the last century or more. But it would not unlikely prove of easier solution if sowing on the well-tried French lines were resorted to. As regards costs, no comparison between the French and British expenditure is possible, as no data on this head are given for Culbin. Successful sowing is, however, infinitely cheaper than planting.

Recent Excavations at the Cheddar Caves.

By R. F. PARRY.

OWING to the increasing number of visitors to the famous caves at Cheddar, Somerset, it became advisable in the winter of 1927–28 to enlarge the entrance. When the cave was first discovered by the late R. C. Gough some thirty years ago, access to the inner portions was obtained by making a cutting through the debris which blocked the cave immediately inside the entrance. This cutting left standing banks of untouched cave earth on either side to a height of 4 ft. 6 in. against the cave walls. While this original work was in progress, many pieces of ancient pottery and flint tools were found, and when in 1903 a cutting was made for drainage purposes a little farther inside the cave, other finds were made, including the skeleton known as the 'Cheddar Man,' part of a *bâton de commandement*, and numerous flint implements.[1]

These earlier finds were made without any pretence to the keeping of any record that could be of use to scientific workers, and it was with the hope of throwing some light on these that the recent necessary work of excavation was carried out in a systematic manner: the excavations were carried down to a depth of 12 ft. 6 in., or 8 ft. below the level of the path; at this depth rock bottom was reached. The soil was removed in 6-in. layers (numbered from the top downwards), and passed through a fine sieve. A careful record was kept of all finds, so that it is possible to refer any specimen to both its horizontal and vertical position in the deposits.

The cave is the course of an underground stream which in olden times flowed from the present cave mouth, but when the water found the lower level that it pursues to-day the cave became a shelter and was inhabited by man.

The stratification was as follows: The upper 2 ft. 6 in. was composed of the well-known red cave earth so common in the Mendip caves; this was followed by 5 ft. 6 in. of a mixture of cave earth and sand, the proportion of sand increasing with the depth. The layers here showed in section a laminated appearance, bands of clayey cave earth alternating with bands of almost pure sand. At 8 ft. 6 in. a bed of gravel 3 ft. thick was reached; it was composed of waterworn limestone pebbles with a few of sandstone, with a filling of red cave earth and sand. This was no doubt the old river bed, and the upper layers also indicate periodical flooding by the river—an event by no means unknown in recent times. Below these layers came 6 in. of sand and clay, with very few pebbles, and at depths varying from 12 ft. to 12 ft. 6 in. the rock bottom of the cave was exposed.

Now going from above downwards the upper layers showed that the cave had been occupied during the Romano-British period followed by Early Iron Age man, who left behind, amongst other things, a fine bone lance head or point very similar to one from Park Brow, Cissbury,[2] and to some from the Glastonbury and Meare lake villages, pottery of distinctive types, and a bronze two-whorl ring. Immediately below these came implements of definitely Palæolithic types. Layers 9 and 10 were somewhat mixed, giving artefacts of both Early Iron Age and Palæolithic date, and showing also a mixture of recent and Pleistocene animal remains. There were no signs of occupation during the Bronze or Neolithic periods, and yet there were no blank layers, and the deposits go without a break from the Early Iron Age into the Palæolithic Age: a decidedly remarkable occurrence.

The first finds of Palæolithic date commenced in layer 7, and continued downwards to the last layer. A large number of flint implements, including knives, scrapers, borers, and burins, were found. In all, 1749 flints were taken from the excavation, 244 of which were definitely worked implements—a proportion of about 14 per cent. The long narrow flake used as a knife of the

[1] Seligman and Parsons, *Jour. Royal Anthro. Inst.*, vol. 44, p. 241.

[2] R. A. Smith, *Archæologia*, vol. 76.

gravette type with the *dos rabattu* back was the most common. The number of flint cores and chips point to the implements having been made on the spot. The raw flint would have to be carried a distance of some 25 miles from the nearest point at which chalk flint would be available. Mr. J. A. Davies, who has reported on the flint implements, ascribes them to the Aurignacian culture developed along native lines and contemporary with the Magdalenian of France.

Perhaps the most interesting find was made in layer 19 (9 ft. 6 in. deep); this was a *bâton de commandement* of reindeer antler. Part of another was found in the same cave in 1903 close to the 'Cheddar Man.' These are the only specimens found in England, though they are not uncommon in some of the French caves. The use of these artefacts is not very clear; some of the French archæologists consider them to be a kind of sceptre carried by the chiefs, but Sir William Boyd Dawkins and Prof. Sollas and others maintain that they were used to straighten arrow shafts.[3] The latter seems to be the more likely theory. The specimen now found has a hole bored through the expanded portion of the antler where a tine branches. This tine has been cut off. The hole is bevelled on either side in a line with the shaft, and the perforation has five lines cut rather deeply on the inside, presumably to give a better grip to the arrow shaft. The instrument is ornamented on either side of the shaft by bands of lines cut lightly and rather roughly into the surface. The lines are not continued right round the shaft, each side having a separate design.

[3] W. J. Sollas, "Ancient Hunters," p. 530.

A rod of ivory and numerous bone piercers and points of a rather distinctive type were found between layers 8-15, and layers 9 and 14 gave us two canine teeth of fox beautifully bored at the root ends for suspension as a necklace ornament. There was also from layer 11 a shell of *Neritoides obtusatus* bored for suspension.

Parts of two human skulls were found in layers 10-13. They have been submitted by Dr. N. C. Cooper to Sir Arthur Keith, who assigns them to the same age as the 'Cheddar Man,' that is, some 12,000 years ago.

The animal remains include wolf, bear and reindeer, Irish elk, arctic fox, and English varying hare.

A full account of the excavations will be published in the next volume of the *Proceedings of the Somerset Archæological and Natural History Society*, where the reports of Mr. J. A. Davies on the flint implements, Mr. H. St. George Gray on the bone and antler implements and pottery, Sir Arthur Keith and Dr. N. C. Cooper on the human remains, and Miss D. M. A. Bate on the animal remains, will appear.

Obituary.

PROF. WILHELM WIEN.

PROF. WILHELM WIEN, of Munich, whose death on Aug. 30 last, at the comparatively early age of sixty-four years, is deeply regretted, was in the front rank of the physical investigators of his time. He was born at Gaffken, near Fischhausen, in East Prussia, where his father was a farmer, and received the earlier part of his education at gymnasia in Rastenburg and Königsberg. He then studied at the universities of Göttingen, Berlin, Heidelberg, and finally at Berlin again, where he was a pupil of Hermann von Helmholtz.

Wien's career, in its outward aspects, was very like that of most successful German men of science. He took his doctorate in 1886 with a thesis on absorption phenomena associated with diffraction. After two or three years as assistant to Helmholtz, he became a 'Dozent' in Berlin in 1892. In 1896 he became professor extraordinary at the Technical High School in Aachen. In 1899 he was appointed professor of experimental physics at Giessen; in 1900 at Würzburg, where he remained twenty years; and finally at Munich.

The immense importance of Wien's contributions to physics was recognised by the award in 1911 of the Nobel Prize. His published papers cover a great variety of subjects, including hydrodynamical researches (no doubt inspired by Helmholtz), electric discharge in rarified gases, cathode rays, positive rays (*Kanalstrahlen*), X-rays, and, most important of all, the theory of black body radiation.

To appreciate properly Wien's work we have to remember that at the time he began as an investigator the Newtonian basis of physics was still held to be something established for all time, and Clerk Maxwell's electromagnetic theory was a new and daring speculation, regarded by many English and most continental physicists with suspicion and distrust. In fact, so far as physical principles and the underlying basis of the science are concerned, physics was thought by many to have reached a state of completion and finality. Among those who prepared the way for the splendid new era in physical science, Wilhelm Wien was one of the most prominent. His greatest achievements are embodied in the two laws of black body radiation which are named after him.

We owe the first serious attempt at a theory of black body radiation to Gustav Kirchhoff, who showed that the character of the radiation in an enclosure, every part of the walls of which has the same temperature, is independent of the nature of the materials forming the walls and is a function of the temperature only. In 1884, Boltzmann deduced from thermodynamic considerations the Stefan-Boltzmann law expressing the total energy density of the radiation in such an enclosure as a function of the temperature. The problem of the distribution of energy among different wave-lengths was still untouched, and Wien's two laws constitute an important advance in the direction of its final solution. His first paper on the subject was

communicated to the Berlin Academy by Helmholtz in 1893 and entitled, "Eine neue Beziehung der Strahlung schwarzer Körper zum zweiten Hauptsatz der Wärmetheorie." In it he showed that the density of the energy associated with the wave-length λ at the temperature T is proportional to the product of the fifth power of the absolute temperature and some function of the product λT. What is usually called Wien's displacement law is an inference from this; namely, that $\lambda_m T$ is a constant, where λ_m is the wave-length where the energy density is a maximum. Experimental proof of it was soon furnished by Paschen and by Lummer and Pringsheim, who found the value of the constant to be approximately 0·29 cm. degree centigrade.

Wien's second great contribution to the theory of black body radiation is contained in his energy distribution formula, published in 1896, according to which the energy density in the neighbourhood of the wave-length λ is proportional to $\lambda^{-5}\exp.(-c/\lambda T)$, where c is a constant. This law agrees with the observations only when the product λT is sufficiently small, and it has not the same sound theoretical basis as the displacement law. It was, nevertheless, of the greatest importance, since it provided Planck with one of the clues he needed for the complete solution of the problem of full radiation. Although it is unlikely that Wien, or anybody else but Planck, dreamt at that time of such a revolutionary innovation as the quantum theory, he certainly contributed to it indirectly.

Scarcely less important than his investigations of the character of black body radiation is Wien's work on the positive rays or *Kanalstrahlen* discovered by Goldstein. In this important line of research he was a pioneer. So far back as the year 1898 he read a paper to the German Physical Society on the electrostatic and magnetic deflection of canal rays. This was the first of a long series of papers on a subject which occupied his attention almost to the time of his death.

Wien was the editor of the *Annalen der Physik*, the greatest and the oldest of the scientific journals devoted to physics in Germany. A fine lecturer and teacher, he was held in high esteem and affection by his students, and they and all who knew him will mourn the loss of Wien the man as much as that of Wien the savant. This brief appreciation and tribute to his memory may fittingly conclude with words which he himself used on the death of the great master Kelvin:

"Now closes a life that was infinitely rich with an inner wealth, a life that it was worth while to have lived."

PROF. P. P. SUSHKIN.

PETER PETROVITCH SUSHKIN was born on Feb. 8, 1868, in Tula, Central Russia. From his early days he was deeply interested in wild Nature, and already as a young student of the University of Moscow made a thorough study of the bird fauna of the Tula, Moscow, and Voronezh provinces and published his first paper, a forerunner of a long series of faunistic studies on birds of various parts of Russia, from the Urals and the Kirghiz steppes to Altai and Mongolia. Explorations of this kind were made possible for him because, as a brilliant student, he received a special research scholarship at the University of Moscow, and in 1901 he was made a lecturer in zoology. In 1910 he was appointed to the chair of vertebrate zoology and comparative anatomy in the University of Kharkov. During the revolution he had to move from Kharkov to the Crimea, where he lectured in the local university for some time, until in 1921 he was elected Keeper of the Ornithological Department of the Zoological Museum of the Russian Academy of Sciences in Leningrad. Two years later he was elected a member of the Academy. His activities in the Academy were numerous, since, besides being in charge of the bird collections of the Zoological Museum, he presided over several permanent commissions, took charge of the newly formed North Dvina gallery of palæozoic vertebrates of the Academy's Geological Museum, and acted as secretary of its physico-mathematical section.

Ornithological science is indebted to Sushkin for his extensive and thorough studies in the faunistics and distribution of birds of the Altai, Kirghiz steppes, Siberia, and Mongolia. In these studies Sushkin always used his unusually wide knowledge of related sciences and tried to apply the distributional data to the solution of general problems of the origin and history of the bird fauna of palæarctic Asia, and his works are of immense value in this respect to every biologist studying any group of animals in Asia. Faunistic work on birds led Sushkin to his attempts to find confirmation of his conclusions with regard to other animals, and he did a considerable amount of work on the distribution of butterflies, since he believed that their distribution follows more or less the same laws as that of birds. Lately, he expanded his views on the history of the fauna of Central Asia so as to include even the problem of the origin of man, and he believed that man originated in the barren mountainous regions of Central Asia.

Apart from faunistic work, Sushkin is well known for his masterly systematic studies of several difficult groups of birds; these papers of his are particularly valuable because of his deep knowledge of the comparative anatomy of birds. Recently, Sushkin undertook a study of palæozoic reptiles and amphibians, and published several important papers on them, but this work has been cut short by his untimely death, which occurred on Sept. 17 last, from pneumonia. He left numerous pupils in Russia and many friends there and abroad, since he travelled in Europe in 1900 and again in 1924 (when he visited also America). A tragic detail, typical of the conditions under which he had to work in recent years, may be added: his flat in Leningrad was broken into during his funeral and everything of value stolen, including some unfinished manuscripts on which he was actually working up to the day of his death.

FRIEDRICH HAYN, extraordinary professor of practical astronomy at the University of Leipzig, died on Sept. 9 at the age of sixty-five years. He was educated at the Dresden Gymnasium and the Universities of Leipzig and Göttingen. He gained his degree with a thesis on the orbit of comet 1862 III. He then obtained a position at Leipzig Observatory, and retained his connexion with that institution in various capacities for nearly forty years. He is perhaps best known for his studies of selenography and the rotation elements of the moon. He also made numerous observations of comets and planets, eclipses of the sun and moon, and carried out triangulations of the Pleiades and the Præsepe cluster. He was also interested in clocks and time-determination. He was appointed professor in 1920; his work as a teacher during the last eight years has been active and fruitful.

WE regret to announce the following deaths:

Sir Hugh Anderson, F.R.S., Master of Gonville and Caius College, Cambridge, a distinguished worker on the physiology of the nervous system, on Nov. 2, aged sixty-three years.

Sir Alexander Kennedy, F.R.S., emeritus professor of engineering in University College, London, and a past president of the Institutions of Civil and Mechanical Engineers, on Nov. 1, aged eighty-one years.

Prof. Theodor Paul, director of the research institute for the chemistry of foodstuffs at Munich and director of the Imperial Health Department at Berlin from 1902 until 1905, on Sept. 30, aged sixty-six years.

Prof. J. G. Pertsch, Jr., professor of electrical engineering, Cornell University, on Aug. 23, aged forty years.

M. Pierre Henri Puiseux, member of the Paris Academy of Sciences, and honorary observer at the Observatory of Paris, and author with Lœwy of a photographic atlas of the moon, on Sept. 28, aged seventy-three years.

Dr. Joseph T. Rosa, Jr., of the branch of the college of agriculture of the University of California at Davis, who had conducted extensive researches on the physiology and genetics of vegetable crops, on Aug. 22, aged thirty-three years.

Dr. Benjamin W. Snow, until 1926 professor of physics in the University of Wisconsin, known for his work on radiation and infra-red metallic spectra, on Sept. 21, aged sixty-eight years.

Sir Charles Tomes, F.R.S., a pioneer in the scientific development of dentistry, who carried out important investigations on the structure and development of the teeth of some of the lower vertebrates, on Oct. 24, aged eighty-two years.

News and Views.

HIS MAJESTY THE KING has approved of the following awards this year by the president and council of the Royal Society in respect of the two Royal Medals: A Royal Medal to Prof. A. S. Eddington, for his contributions to astrophysics; a Royal Medal to Prof. R. Broom, for his discoveries, which have shed new light on problems of the origin of mammals. The following awards have also been made by the president and council: The Copley Medal to Sir Charles Parsons, for his contributions to engineering science; the Rumford Medal to Prof. F. Paschen, for his contributions to the knowledge of spectra; the Davy Medal to Prof. F. G. Donnan, for his contributions to physical chemistry, particularly for his theory of membrane equilibrium; the Darwin Medal to Dr. L. Cockayne, for his contributions to ecological botany; the Sylvester Medal to Prof. W. H. Young, for his contributions to the theory of functions of a real variable; the Hughes Medal to M. le Duc de Broglie, for his work on X-ray spectra.

THE following is a list of those recommended by the president and council for election to the Council of the Royal Society at the anniversary meeting on Nov. 30: *President*, Sir Ernest Rutherford; *Treasurer*, Sir David Prain; *Secretaries*, Sir James Jeans and Dr. H. H. Dale; *Foreign Secretary*, Sir Henry Lyons; *Other Members of Council*, Dr. F. A. Bather, Dr. C. Bolton, Dr. C. G. Douglas, Mr. R. H. Fowler, Prof. E. W. Hobson, Sir Frederick Hopkins, Prof. A. Lapworth, Prof. J. C. G. Ledingham, Prof. F. A. Lindemann, Dr. P. C. Mitchell, Prof. J. C. Philip, Prof. A. C. Seward, Prof. G. Elliot Smith, Sir Thomas Stanton, Mr. A. A. C. Swinton, and Prof. C. T. R. Wilson.

THE immense practical importance of virus diseases of plants is being increasingly recognised, and it is a pleasure to note that the investigation of their more fundamental aspects has not been lost sight of. Generous provision has now been made for the latter by a grant from the Empire Marketing Board to the Rothamsted Experimental Station. This will allow of the addition to the staff of the Station of a plant physiologist, a cytologist, and an entomologist, together with adequate maintenance, equipment, and laboratory assistance. The grant also provides for the erection of a range of insect-proof glasshouses with special facilities for virus researches. The appointments will be to the Department of Mycology, of which the head is Dr. W. B. Brierley. The chief of the Section of Virus Diseases in the Department is Dr. J. Henderson Smith, whose work in this field is already well known, and the intimate co-operation of a medical bacteriologist, a plant physiologist, a cytologist, and an entomologist in the intensive study of the more fundamental aspects of virus diseases marks a noteworthy step forward in the exploration of this congeries of very difficult and obscure problems. Further, this group of workers will be an integral portion of a research department of mycology, and thus carry out their investigations in the closest association with workers on fungous and bacterial diseases of plants and general plant pathology. The Empire Marketing Board is to be congratulated on its wisdom in making this development possible, and it is hoped that the Department of Mycology at Rothamsted will become an Empire centre for the study of virus diseases of plants where workers from at home and overseas will be welcomed and find facilities unobtainable elsewhere.

THE centenary of the *Spectator*, which again recalls by its name the earlier publication of Addison and Fielding, was celebrated last week by the issue of a voluminous and interesting number, giving both the history of the review since 1828 and general articles by many leading writers in science, literature, and politics. It may well claim an honoured, and even a unique, position among English journals. With the *Times* and *Punch* it probably represents better than any other paper the mental attitude of the English cultivated middle class, which is, in the broad sense, liberal, without being revolutionary, very open to useful new ideas while tenacious of the settled traditions of the country, eager to redress palpable injustice while avoiding sensations and dangerous adventures. The *Spectator*, founded by an ardent and outspoken Scot, R. S. Rintoul, and established by Meredith Townsend and R. H. Hutton, tended during the long editorship of J. St. Loe Strachey rather to the conservative side. This was due, as in so many other cases, to the split over Home Rule, and, the Irish question being now out of the way, it has resumed a more comprehensive attitude. Its circulation has recovered, and is far higher than even in the palmy days of Townsend and Hutton.

IT is pleasing to notice that in this centenary number of the *Spectator* considerable space is given to articles on the progress and prospects of science. Both Sir Oliver Lodge and Sir Alfred Ewing contribute papers. This way undoubtedly lies the best hope of the future, especially for the classes of people who read the *Spectator*. There is great scope and great need for a further admixture, both of the results and still more of the spirit of science, in publications which appeal to the general reader and must perforce give their main space to books and politics. While the scientific journal becomes more specialist, the general aspects of science will need more constant presentation to the non-specialist. We congratulate our veteran contemporary most heartily on its long course so brilliantly executed and the vigour with which it faces the tasks of another century.

ABOUT thirty years ago V. Poulsen of Denmark invented the telegraphone, an instrument for recording sounds in such a way that they can be reproduced. In the case of the gramophone, the recording and reproducing are purely mechanical, but the telegraphone is worked magneto-electrically and can be operated from a distance. The principle on which the instrument acts is that of magnetising in varying strengths the successive points of a thin steel wire as it is moved past the pole or poles of an electromagnet, the winding of the electromagnet being in the secondary circuit of an induction coil connected with a microphone. On speaking into the transmitter, the induced currents in the secondary produce variations in the magnetic field which cause the moving wire to be permanently magnetised in different intensities along its length. If we pass the steel wire magnetised in this way in the same direction as it originally passed the poles of the electromagnet, the receiver produces the original sounds, the loudness, however, being much diminished. It was proposed many years ago to use the instrument for the recording of conversations held over an exchange telephone line. When the subscriber is absent, the ringing of his bell automatically starts and switches in his telegraphone. On the return of the subscriber his telegraphone repeats the caller's message. The sounds heard in the telegraphone were quite clear and were free from extraneous noises, but they were faint, and in most common battery telephone circuits the results were poor.

A CONSIDERABLE step in advance in developing the telegraphone has recently been made by Dr. Curt Stille. According to the *Times* of Nov. 1, a British group of financiers has obtained from a German bank the rights of manufacture for the whole world outside of Germany. It is claimed that the new machine can be used for recording speeches and office letter dictations, the wire 'record' being wound on a spool. It can also be used to record telephone messages. It is claimed that the provincial and foreign correspondents of newspapers will thus be able to transmit news by telephone at a quarter of the present cost. A demonstration of the new apparatus was given in London on Oct. 31. Among the items recorded were a vocal solo, a recitation, and an orchestral selection. After a few minutes' waiting the mechanical process was reversed and the complete programme was reproduced. The reproduction, although the tonal effect was not quite so good as a gramophone, was clear and strong. Some of those present spoke into the machine and heard the reproduction of their voices immediately afterwards.

IN his presidential address to the Institution of Electrical Engineers, delivered on Oct. 25, Colonel Edgcumbe discussed mainly the economics of engineering production. It was encouraging to hear him prophesy that the electrical industry will double, and possibly even treble, its production in about fifteen years' time. There is the important limitation, however, that no industrial upheavals occur in the interval. He touched on more controversial matter when he suggested that the British manufacturer should be protected from foreign competition in the home market, although he modified the suggestion by saying that it should only be for a limited period. He made the proposition very attractive by saying that if the manufactured goods of the value of 100 millions sterling at present being imported into Great Britain were made here instead we could find employment for 800,000 men and thus solve the unemployment question. He does not grudge our foreign friends their orders, but merely regards tariffs as an economic necessity of the moment. He said that when a corporation places an order for £50,000 abroad the chief sufferers are the unemployed, some 500 operators being kept out of employment for about six months. In order that a country may have a high standard of living it is necessary to have a high rate of production per annum. In the United States and in Canada the yearly output per operative is nearly £900; in Great Britain it is only about half this. The relative pur-

chasing power of the hourly wage in America is nearly double that of our own. We think that his suggestion of selling a certain fraction of a factory's output overseas at cost price, or even slightly less, is a sound one. He shows how it might actually bring down the cost to the home purchaser. Electrical undertakings nearly always sell ' power units ' at a much cheaper rate than ' lighting units,' and this policy can be justified. It is no easy matter for one manufacturing country to compete with another where working hours are longer, wages are lower, and where also luxury, entertainment, and living are on a much lower plane.

IN his Cameron lecture, delivered to the University of Edinburgh on Oct. 30, Dr. F. G. Banting gave a historical account of the research that resulted in the discovery of insulin. It was exactly eight years previously, on Oct. 30, 1920, that he conceived the idea that, if he ligatured the pancreatic duct and allowed the pancreas to degenerate, he might be able to obtain from the degenerated pancreas an active extract of the islets of Langerhans. He obtained permission to try out this idea in the Department of Physiology in the University of Toronto, and also obtained the services of Dr. Best, who was then a medical student, for help in estimating blood sugars. Work was commenced in May 1921, and the extracts from degenerated pancreases were found to lower the blood sugar and to produce clinical benefit in depancreatised dogs. A more adequate supply of islet extract was found to be available in the pancreases of fœtal calves, and from the material thus obtained something was learnt of the solubility of the active principle. This led to the discovery of a method by which active alcoholic extracts could be obtained from the pancreases of adult cattle.

CONTINUING, Dr. Banting said that in January 1922 the pancreatic extracts were first tried on diabetes patients. The results were sufficiently encouraging to cause Prof. J. J. R. MacLeod to turn a large proportion of his staff to work on the problems of the physiological activity of the pancreatic extract. Very soon the results were such as to attract general attention, and from that time onwards intensive investigations on insulin have been conducted all over the world. Prof. Banting succeeded where many failed, and this fact lends special interest to the concluding words which he addressed to his large audience of students. " I am a firm believer in the theory that you can do anything that you wish in this world, within reason, if you are prepared to make the sacrifice, think and work hard enough and long enough.

'There is no chance, no destiny, no fate
Can circumvent, can hinder or control
The firm resolve of a determined soul.
Gifts count as nothing. Will alone is great;
All things give way before it soon or late.' "

PATENT law, which ought to operate to the encouragement and reward of chemical investigation, frequently exercises a quite contrary effect. Remarking that chemical invention differs in many respects from mechanical invention, Mr. F. H. Carr, the immediate past-president of the Society of Chemical Industry, referred in his recent presidential address to the unsatisfactory state of legislation in this matter, and offered the suggestion that chemists in various countries should endeavour, in some concerted manner, to encourage research, to maintain a truly international spirit in science, and to secure a just reward to the inventor for the improvement in industry resulting from his invention—the reward, moreover, including recognition of the value of researches freely published in scientific journals. Such preliminary action should lead to an improvement in the unification of patent law and avoid the necessity for much of the secrecy which surrounds many important manufacturing operations and investigations carried out in connexion therewith. On one hand, a large number of chemical patent specifications are designed to bar the field of research to other workers, and, on the other hand, many successful inventions yielding large royalties are based on the scientific work of others who have not sought patent protection.

MR. CARR'S stimulating address was not confined to criticism, however justifiable, but discussed the work of the research associations, and referred to some of the major advances of chemistry and chemical industry, naturally with particular reference to those based on researches carried out in Great Britain and the United States of America. Mr. Carr concludes—and few competent judges will disagree—that industrial leadership should be entrusted to those who understand science and are therefore able to judge the value of an invention; further, that amalgamation, whether of firms or of their research departments, should be accompanied by the provision of effective scientific leadership invested with a proper degree of influence in relation to commercial and financial affairs. With Mr. Carr, and with all scientific workers of goodwill, we hope that when the world is finally released from the fear of war and from the fear that our civilisation may suffer destruction through the power of science, nations will combine to promote with greater intensity the objects of science in harnessing the resources of the world to the betterment of mankind.

IN 1781 there was published at Mannheim, on behalf of one Henry Zimmermann, an account of the third voyage (1776–1779) of Capt. James Cook. Not long ago the Alexander Turnbull Library, Wellington, N.Z., prepared and issued a translation of this record, for which we believe Miss Tewsley, of the library staff, was mainly responsible. Much interesting matter is made generally available thereby. Zimmermann's narrative informs readers that in the year 1776 two war-sloops, the old *Resolution* and *Discovery*, were being sent out on an exploring expedition, and he signed on the latter as a common sailor. She had 72 men and 12 guns aboard, and in command, Capt. Charles Clerke. " Fearing," he says, " as indeed proved to be the case, that we sailors would be obliged either to give up, or to destroy, all papers dealing with public matters, I took the precaution to write down briefly, and in the German language, all the principal

events which took place. It is from this notebook and my memory that I have drawn the materials."

ON Thursday last, Nov. 8, occurred the centenary of the death of Thomas Bewick, celebrated for his woodcut illustrations of animals and birds. A north-countryman, he was born at Cherryburn, Northumberland on Aug. 12, 1753, and died at Gateshead on Nov. 8, 1828. Early in his career, and whilst in apprenticeship at Newcastle, Bewick secured the valuable patronage of Dr. Charles Hutton, the mathematician, whose treatise on mensuration was in progress. After working in London for a short time Bewick returned to Newcastle. In 1790 appeared "A General History of Quadrupeds"; in 1797 the first, and in 1805 the second, volume of his "History of British Birds," considered to be his premier work. For R. J. Thornton's "Family Herbal" (1814) Bewick prepared two hundred and fifty-eight engravings exemplifying plants drawn from Nature by Henderson. He also designed the woodcuts in Robert Bloomfield's "The Farmer's Boy" (1800). Bewick rendered distinct service to the science of his time as an interpreter, through spirited and facile engravings illustrative of many branches of natural history in the wild. He did not profess to be other than an observant student, but fine craftsmanship was at his call. To the country gentleman he was an inspiration. Reference to the British Museum Catalogue of Printed Books will show the nature and astonishing variety of his illustrative efforts. His accessories, backgrounds, vignettes, and tail-pieces bore each a story. There is a portrait of Bewick by James Ramsay in the National Portrait Gallery.

THOSE of our readers interested in Prof. Bone's article in the issue of Sept. 1 on "The Centenary of James B. Neilson's Invention of Hot-Blast in Iron Smelting," will be glad to know that the West of Scotland Iron and Steel Institute has recently published in booklet form a short life of Neilson, compiled by Mr. T. B. Mackenzie. Included in this booklet are a portrait of the inventor, a reproduction of the painting showing Neilson, Macintosh, Wilson, and their law agents, made after the great 'hot-blast trial' at Edinburgh, and some sketches showing the early application of the hot blast. Extracts are also given of Neilson's address at the opening of the Workmen's Institution which he founded at the Glasgow Gas Works, and Neilson's own account of the steps by which he was led to his epoch-making invention. The latter is extracted from the reports of the discussion which took place on a paper read by Mr. H. Martin before the Institution of Mechanical Engineers in Birmingham, "On the Construction of Hot Blast Ovens for Iron Furnaces," the paper being read on May 4, 1859, and the discussion taking place on July 27. Neilson undoubtedly belonged to a clever family, and in the brief biographical sketch we are given we see him as a man of quiet, reflective mind, strict in his religious and social duties, unassuming and kind, and invariably actively interested in the welfare of those around him. We are not told what fortune he made or left, but in concluding his interesting review Mr. Mackenzie remarks: "It may be estimated that as a result of Neilson's invention of the hot blast his country has benefited to the extent of about twelve million pounds sterling per annum."

THE destructive winds that occurred in several places in the south-east of England, including a part of London, on Oct. 22, have been the subject of an official inquiry by the Meteorological Office. The request for information from private individuals met with such an unexpected response—264 letters and 217 barograms had been received up to Nov. 3—that the inquiry is still in progress. It has been established, however, that the London storm travelled slightly east of north on a straight path of very narrow width, from near Victoria station to Highgate, but it was diminishing in severity by the time it had reached Euston, and no damage was reported until a fresh access of energy took place at Highgate. Barograms on the storm's path showed a very sudden fall and recovery of pressure, amounting as a rule to two or three millibars. The phenomena observed were similar in character to those of an American tornado, but although the wind was of destructive violence it was less strong than that of a typical American storm. It was unfortunate that it occurred after dark, as this made it impossible to tell whether the characteristic 'funnel cloud' was present. Events of a similar nature took place on the same evening at Bromley (Kent), where a track parallel to that of the London tornado was followed, and near Southampton. It may be recalled that in 1913 a tornado occurred on nearly the same date in South Wales, and resembled this one in that its track was very narrow and was from south to north; on that occasion also it practically died out, only to reappear farther north, and there was at least one other outbreak of the same kind in another part of Great Britain

EXPLANATIONS of the precise conditions under which a tornado arises are somewhat speculative, owing to want of sufficiently detailed observations of atmospheric structure in the immediate neighbourhood. It is evident that they develop most often, as did the London storm, at the discontinuity between different wind currents, but it is unlikely that the differences in density between the different currents provide any appreciable part of the kinetic energy of the whirl, which must presumably come from the latent heat set free in the condensation of water vapour into rain. According to this view, tornadoes may be more frequent in America because of the nearer presence of large areas of warm sea-water capable of supplying the necessary water vapour, and not, as has sometimes been assumed, because of the greater contrasts of temperature there.

THE U.S. coastguard patrol vessel *Marion* returned to New London, Conn., on Sept. 18, after a ten weeks' cruise in the waters between Greenland and Labrador; and some preliminary information as to the main results has been received. More than 2500 soundings were made with the echo gear. The larger part of the area was found to have a depth of more than 1000 fathoms, and 2000 fathoms or more was reached at

the southern end. The Greenland shelf is not so wide as was supposed, and has a very abrupt outer edge. The Labrador shelf, on the other hand, is wider than it is generally charted, and has a remarkable trough in it, running parallel to the coast, at a distance of 40 miles, for the greater part of its length. More than 2000 records of temperature and salinity were obtained at various depths at 191 positions, intended for the dynamical calculation of the speed of the ice-bearing currents on the basis of the work of V. Bjerknes. This will take a considerable time, but so far as they have been examined they have led the officers of the expedition to some unexpected conclusions. No trace of a warm north-going undercurrent was found in Davis Strait, and it is suggested that the openness of the North Water is due to the shape of the basin. A layer of water 100 metres thick covered the larger part of the deep area with "a temperature 5° above normal." The deep-bottom water had a temperature of 2·6° C., and a salinity of 34·90, and, in the opinion of the leader, Lieut.-Commander E. H. Smith, is not formed locally, but has crept slowly northwards from the Antarctic regions. Warm Atlantic water pushed in past Cape Farewell, and apparently kept well over to the Greenland side; on the Labrador side water of low salinity extended far seawards. About 1000 bergs were seen off Disko Island, and 200 near Cape Harrison. No pack-ice was found south of Cumberland Sound.

AT the International Conference for Phytopathology and Economic Entomology, held in Holland in 1923, a prize fund was inaugurated at the instance of Prof. Eriksson, who contributed a substantial sum to it. Other contributions were made and sums collected, so that the standing committee of the Conference is now able to announce the offer of two prizes of the value of 1000 Swedish crowns (about £55) each. The prizes are to be awarded for the best two memoirs concerning: (1) investigations on rust (Uredineæ) diseases of cereals (wheat, oats, barley, and rye); and (2) investigations on the rôle played by insects or other invertebrates in the transmission or initiation of virus disease in plants. Competitors may be of any nationality, and memoirs (which may be in English, French, or German) must reach the Secretary of the Committee on or before May 30, 1930. The awards will be announced, after adjudication by two boards of specialists of international reputation, during the International Botanical Conference in Cambridge in 1930. Full particulars of the scheme may be had on application to the Secretary, Mr. T. A. Schoevers, Wageningen, Holland.

THE first Liversidge Lecture before the Chemical Society, entitled "Physical Chemistry in the Service of Biology," will be delivered by Prof. F. G. Donnan in the meeting hall of the Institution of Mechanical Engineers on Thursday, Nov. 29, at 5.30 P.M. The lecture is open to the public, without ticket.

PROF. A. R. LING, of the University of Birmingham, will deliver the eleventh Streatfeild Memorial Lecture before the Institute of Chemistry in the Lecture Theatre, King's College, Strand, W.C.2, on Friday, Nov. 16, at 8 P.M., taking as his subject, "Contributions to the History of Starch and its Transformation Products." Admission is by ticket, obtainable free of charge, from the registrar of the Institute of Chemistry, 30 Russell Square, London, W.C.1.

IT has been decided by the council of the British Institute of Radiology incorporated with the Röntgen Society, to hold a special meeting at the opening of the new session on lines similar to last year, when the inaugural meeting of this body was celebrated. On the present occasion, in addition to the address by Dr. G. W. C. Kaye, the president for 1928–29, papers have been promised by Prof. W. L. Bragg, Sir Thomas Horder, Mr. W. Sampson Handley, Mr. A. T. Walton, Dr. G. Shearer, and other distinguished workers in the radiological world. Most of the meetings will be held at the Central Hall, Westminster, and at the same time there will be shown examples of the most modern X-ray and allied apparatus, which will include exhibits by all British firms engaged in this industry. The proceedings are not open to the general public, but any person practically interested in radiological work is invited to attend. The Director of the Institute, Dr. J. Muir, 32 Welbeck St., London, W.1, will give any information desired.

INTENDING purchasers of publications of the U.S. Bureau of Standards, such as the *Journal of Research*, obtainable through the Superintendent of Documents, Washington, will be glad to have the information forwarded to us by a correspondent, that the Superintendent of Documents will not accept cheques, but only international money orders.

THE reviewer of "British Rainfall" in NATURE of Nov. 3, p. 678, suggested that Mr. L. C. W. Bonacina's article on the snowfall of the half-century from 1876 to 1925 was inspired by the heavy snowfall in the south of England last Christmas. Mr. Bonacina writes to correct this impression. His article was actually in typescript last November, and the reference to the Christmas snowstorm was added afterwards.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A chemical assistant in the bio-chemical laboratory of the General Hospital, Birmingham—The House Governor, General Hospital, Birmingham (Nov. 13). Two assistant inspectors of weights and measures under the Somerset County Council—The Clerk of the Somerset County Council, Boulevard, Weston-super-Mare (Nov. 15). A temporary technical assistant on farm economics under the Board of Agriculture for Scotland—The Secretary, Board of Agriculture for Scotland, Queen Street, Edinburgh (Nov. 15). A senior assistant in the chemical department of the West of Scotland Agricultural College—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (Nov. 15). A lecturer in mechanical engineering at the Aston Technical College—The Chief Education Officer, Birmingham (Nov. 16). An assistant at the Low Temperature Research Station, Cambridge, with

knowledge of physics and biology, for work in connexion with the preservation of fruit and vegetables —The Superintendent, Low Temperature Research Station, Cambridge (Nov. 17). A lecturer in electrical and mechanical engineering at the College, Swindon—The Principal, The College, Swindon (Nov. 17). A research assistant under the Safety in Mines Research Board for work in connexion with wire ropes used in coal mines—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (Nov. 19). An assistant lecturer in dairy husbandry in the department of agriculture of the University of Leeds—The Registrar, The University, Leeds (Nov. 19). An agricultural entomologist at the Kirton Agricultural Institute—The Principal, Kirton Agricultural Institute, Kirton, nr. Boston, Lincs. (Nov. 20). An assistant to the public analyst of the City of Manchester—The Medical Officer of Health, 1 Mount Street, Manchester (Dec. 1). A physiologist, a cytologist, and an entomologist at the Rothamsted Experimental Station, for research on virus diseases of plants—The Secretary, Rothamsted Experimental Station, Harpenden (Jan. 31). An agronomist under the Director of Investigations of the Australian Tobacco Investigation—F. L. McDougall, Room 321, Australia House, Strand, W.C.2. An investigator on aluminium founding, under the British Non-Ferrous Metals Research Association—The Director, British Non-Ferrous Metals Research Association, 71 Temple Row, Birmingham.

ERRATUM.—Mr. K. Sreenivasan, referring to his letter entitled "Long Wave Radio Reception and Atmospheric Ozone" in NATURE of Oct. 27, p. 646, informs us that while correcting the proof he overlooked a mistake on p. 646, near the bottom of col. 2. The figure for correlation given there is $1 \cdot 77 \pm 0 \cdot 23$; it should be $1 \cdot 77/2 \pm 0 \cdot 023$, that is, $0 \cdot 88 \pm 0 \cdot 023$.

Our Astronomical Column.

TAYLOR'S COMET.—Herr Reinmuth, of the König-hl Observatory, announces that he made a careful rch by photography for Taylor's comet on two hts without success, which gives ground for apprension that this comet is following the example of the t comet of Biela ; it will be remembered that ela's comet divided into two portions in 1846 ; the o portions were again seen six years later, but then nished completely Taylor's comet likewise divided o two portions in 1916. It was too badly placed in 22 to make observation possible. It looks as though ision into two nearly equal portions is too great a ain on a comet's constitution for it to survive long as visible object. However, it is too early yet to give hope, as the comet is approaching the earth, and so coming into a better position in the morning sky.

THE LEONID METEORS.—Prof. Harlow Shapley, in *arvard Announcement Card*, No. 74, reminds obrvers that the maximum of this shower is due in 31 and 1932 ; he asks for half-hour counts of meteors be made each night, from Nov. 10 to 17, at as many ations as possible ; if this is done each year until e maximum is past, it will give useful information n the distribution of density on each side of the aximum. He also asks for calculations to be made s to the perturbations of the swarm since 1899 ; it ill be remembered that in 1899, Drs. Downing and ohnston Stoney calculated that the action of Jupiter ould cause the dense part of the swarm to miss the arth ; this was in fact verified, but their prediction as published too late to warn the public, so that great isappointment and considerable distrust of astronomical predictions resulted.

There is a special difficulty in such predictions ; the eriods of the earth and meteors not being exactly ommensurable, we meet each time a portion of the swarm that has not met the earth before, so that we have to guess its position, guided by our knowledge of the positions of other portions of the swarm at a considerable distance away from it.

DISTURBANCES ON JUPITER.—Rev. T. E. R. Phillips spoke on this subject at the October meeting of the British Astronomical Association. Mr. B. M. Peek observed a curious marking south of the south tropical belt early in August. This expelled a number of small dark spots that travelled at a great speed in the direction of increasing longitude. They gave a rotation period of 9 h. 59 m., which is the greatest ever recorded. They were carefully watched as they approached the Great Red Spot. The majority of them were deflected into a curved path which went round the Spot on the north side. As they passed the narrow passage between the Spot and the equatorial belt, they were drawn out into elongated ovals, suggesting a strong current through the narrows. They were followed for a short distance after this and then melted away. A few of the spots hazarded the direct path across the Red Spot, but they suffered for their temerity, as they were lost to sight and never reappeared. Mr. Peek's original marking also produced a region of irregular disturbance, which travelled, though much more slowly, in the opposite direction, that of diminishing longitude.

News of the disturbance was sent by cable to Dr. Wright, and it is hoped that he may have obtained some photographs of the phenomena in light of different wave-lengths ; such photographs give information on the relative heights of markings. R. A. Proctor used to explain markings with a long rotation period as having come from a great depth, where the rotational speed was less, so that they lagged behind on reaching the surface.

THE GREAT FIREBALL OF SEPT. 30.—Mr. W. F. Denning writes : "This object passed over the north of England, its luminous flight beginning over Hawick, then passing over Northumberland in a direction to east by south ; it continued its course far out over the North Sea to the region of the Dogger Bank. About seventy-five accounts of the fireball's appearance were received, and from the best of these the object appears to have had a height of from about 60 to 21 miles along a path of about 160 miles, which it traversed at a velocity of about 18 miles per second. The radiant point was at $220° + 16°$, near the star Zeta in Boötes, which was about 15° above the horizon a few degrees north of west at the time of the meteor's appearance. The light it gave startled some of the many observers in Yorkshire, Durham, and other northern counties. No detonation was heard, but it appears highly probable that the object fell into the sea. Many persons allude to the fireball as appearing to be quite low in the air, several estimates of the height being 50 yards, 100 yards, and 100 feet. Two of the observers state that they distinctly heard a 'fizzing' noise as the object passed. Errors of this kind are often made, however, by persons who lack experience in observing such phenomena."

Research Items.

A CHINESE FRESCO OF T'ANG STYLE.—A second fresco from the Moon Hill Buddhist Monastery near Ch'ing Hua Chên in Honan Province has been acquired by the Museum of the University of Pennsylvania, and is described by Miss Helen E. Fernald in the *Museum Journal*, vol. 19, No. 2. It comes from the wall which faced the first fresco in the monastery, and is nearly perfect, showing greater intensity of colour and greater massiveness than the first in the central Buddha figure. It is eighteen feet in height and twenty-nine feet long. In design the style is that of the T'ang dynasty. The centre is occupied by a huge figure of Sâkyamuni Buddha seated on the lotus throne. On each side is a huge Bodhisattva sitting European fashion turned 'three-quarters' towards the Buddha. In the foreground between the Buddha and the Bodhisattva on each side are two graceful Bodhisattvas. Another Bodhisattva holding a bowl and pomegranate, and a child worshipper, complete a group which is surrounded by a number of military-looking figures in armour and jewelry, probably devas. In colour the whole is magnificent. The painting appears to belong to a convention of grouping which became traditionally established in sculpture and painting early in the T'ang dynasty, representing the Buddha with two attendant Bodhisattvas, and a host of other adoring beings. Although very few early Chinese frescoes exist to-day, it is recorded that enormous numbers of them were painted during the T'ang period and earlier. Probably they were destroyed in the rising against foreign religions in the ninth and tenth centuries.

AN AZILIAN STATION IN ARIÈGE.—An account of the recent excavation of a cave at Montardit (Ariège), known as the 'Trou Violet,' by Ida Vaillant-Couturier Treat and Paul Vaillant-Couturier, is given in *L'Anthropologie*, vol. 38, Nos. 3-4. The cave was first identified as an archæological station some twenty or more years ago, when a superficial examination brought to light neolithic remains. Shortly after, further evidences of occupation were found, as well as a fragment of the pelvis of a child, though in the interval a considerable quantity of cave earth was removed by the peasantry for use as fertiliser. Systematic excavation was begun in 1926, and has been continued regularly since then. It has been carried through a series of five stratifications down to bedrock. Of these, the fourth is Magdalenian, while the second, immediately below the disturbed area, is Azilian. The conformation of the cave is peculiar. A platform or sill is succeeded by an almost vertical drop, making the remoter part of the cave an almost well-like shaft. By Azilian times, this had been practically completely filled in and provided a floor of considerable area, extending beneath the whole vault. Two interments were found which unquestionably belonged to Azilian times and had not been introduced by later inhumation. In one the remains were practically complete, but the other had been disturbed either by animals or man, and only a skull cap, clavicle, and a few other bones remained. It is concluded that the cave was used occasionally rather than as a place of regular occupation in late Magdalenian times, and similarly in early Azilian times, but that gradually it came to be regularly occupied, even after it had been used for sepulchral purposes. The human remains are comparable with those of Mas d'Azil, Ofnet, and Mugem. The discovery of pebbles showing traces of colour related the site to the lower of Piette's sites at Mas d'Azil, which is only a few kilometres away.

VITAMIN CONTENT OF RICE.—Investigations have been made to determine a satisfactory standard for beriberi-preventing rices (E. B. Veddar and R. T. Feliciano, *Phillipine Jour. Science*, 35). No rice of the series examined produced polyneuritis when fed to pigeons, provided that 50 per cent or more of the external layers of the grain were present. The proportion of these requisite layers was determined with reasonable accuracy by simple inspection after staining with Grams' iodine solution. For practical purposes, human beriberi can also be prevented by selecting rice in this manner, though it cannot be recommended as a legal standard. It is suggested that races be classified as highly-, medium-, or undermilled according as they retain 0 to 20, 21 to 49, and 50 to 100 per cent of the external layers. From the chemical side, 1·28 per cent fat is the best single index for a beriberi-preventing rice. 0·62 per cent phosphorus pentoxide is fair, 1·05 per cent ash is poor, while amido-nitrogen is useless for the purpose. A definite chemical index is proposed for use as a standard for beriberi-preventing rice. No rice possessing these requirements produced polyneuritis in pigeons, and as pigeons are much more susceptible to the deficiency of anti-neuritic vitamin than is man, this standard will not only protect man, but will also provide a margin of safety. This factor of safety is necessary, as the vitamin content may be reduced by defective storage or preparation for food. Experiments with insect-infected rices indicate the probability that the loss of vitamin during long storage of undermilled rice is caused by the depredation of insects that eat the external layers of the grain.

SOUND-PRODUCTION IN BOOK-LICE.—In the *Entomologist's Monthly Magazine*, August 1928, Mr. J. V. Pearman has an interesting communication on this subject. For many years various writers have claimed that certain Psocoptera or book-lice are capable of producing an audible ticking noise (the 'death watch'). Others have denied the capability of sound production by such minute fragile insects. Mr. Pearman, however, has been able to demonstrate that the species *Clothilla pulsatoria* is able to make audible sounds by tapping a slightly thickened knob, near the apex of the ventral side of the abdomen, against the substratum upon which the insect is resting. The sound is most distinct when the creature is placed upon paper, more variable when it is on cardboard or wood, and non-audible on glass. The sound-production appears to be confined to the female, and is considered to be a mating call. In certain other Psocids the inner surface of each hind coxa bears a scale-covered swelling which, in some species, has a kind of tympanum or presumed resonator situated just behind it. It is suggested that these organs are also for sound-production, and that the sound is made by the scaled swellings of the two legs being rubbed together. These organs are more largely developed in the males, and the hypothesis of their sound-producing function is, at present, conjectural.

BLOOD VASCULAR SYSTEM OF THE SPINY DOGFISH.—The spiny dogfish, *Squalus acanthias*, is common off the coasts of the British Isles, and is not infrequently used instead of the common dogfish for class purposes. Until now, no adequate description of the blood system has been available, and the account given by Dr. O'Donoghue and Miss Abbott (*Trans. R. Soc. Edin.*, vol. 55, pt. 3, No. 33; 1928) will be specially welcomed by university teachers. The authors find the vascular

system of this dogfish one of the most primitive and least specialised of any Elasmobranch so far described. The presence of six complete branchial arches between the dorsal and ventral aortæ in the embryo, as in the embryo of all the higher vertebrate groups, and their more or less complete retention in the adult, suggest that the higher vertebrata had a remote ancestor the branchial circulation of which is most nearly approached in living forms by the pentanchid selachians. The authors have interpreted the blood system in the light of recent embryological work, and have suggested a terminology for some of the vessels which is more suitable and useful in comparing the conditions in Elasmobranchs with those in other and higher vertebrate groups. The paper is a valuable and much-needed contribution to the comparative anatomy of the vertebrate blood system.

PHILIPPINE TREMATODES.—In a paper on the Trematodes of Philippine fish, frogs, birds, and bats, M. A. Tubangui (*Philipp. Jour. Sci.*, **36**, No. 3; 1928) describes a dozen new species and a new genus. The most interesting is a new species of *Opecœlus* in which an anus is present. The two branches of the intestine unite not far from the posterior end of the worm, and form a short narrow canal which opens to the exterior through an anus which is not quite terminal but is situated on the ventral surface. This worm occurs in the intestine of two species of *Glossogobius*. In two Japanese species of *Opecœlus* from the intestine of fishes an anus is present (Ozaki, 1926).

AMPHIBIANS OF WESTERN NORTH AMERICA.—A recent *Occasional Paper of the California Academy of Sciences* is a detailed account of the amphibians of the western States, illustrated by original photographs from living specimens. Although the amphibian fauna of the area is stated to be not very numerous, the present account (by Joseph R. Slevin) admits 46 species and sub-species, of which 22 are salamanders and 24 are frogs, toads, etc. The specific characters of these are described in detail, and short notices given of distribution and habits. Although many of the islands on the western coast of North America contain one or two species, and Vancouver shelters as many as six, it is a striking fact that no amphibians have been found on the islands in the Gulf of California.

EXPERIMENTALLY-INDUCED METAMORPHOSIS IN ECHINUS.—Prof. Julian S. Huxley records observations (*Amer. Naturalist*, **62**, 363-376; 1928) on experimentally-induced metamorphosis in *Echinus*. Treatment of advanced larvæ of *Echinus miliaris* with very dilute solutions of mercuric chloride (about $M/(2 \cdot 10^6)$), rapidly brings about precocious metamorphosis. This appears to be caused through the differential susceptibility of larval tissues and echinus rudiment; the former are more affected by the poison, begin to dedifferentiate, and can then be readily resorbed by the echinus rudiment. When the echinus rudiment is small, metamorphosis is less rapid and may be incomplete, both larval and echinus tissues being dedifferentiated. It is suggested that a similar mechanism is operative in the normal metamorphosis of echinids; the larval tissues dedifferentiating when the weight of the echinus rudiment causes the organism to sink away from the favourable conditions for food and oxygen at the surface of the sea.

NEW BRITISH FRESHWATER PEARL MUSSEL.—An extraordinary find has just been made of a new species of freshwater pearl mussel in the British Islands. Mr. R. A. Phillips describes this find, which comes from the River Nore, at Durrow, Queen's County, I.F.S., under the name of *Margaritifera durrovensis* (*Proc. Malac. Soc. Lond.*, vol. 18). It differs from the well-known form, *M. margaritifera* (Linn.), in habitat, for it dwells in deep shady pools in hard water, instead of quick running streams of soft water, so that the umbones are not eroded, and the posterior end of the shell which projects up into the water as the animal crawls along the bottom becomes coated with 'race.' It differs also in its external form and umbonal rugæ as well as in the teeth and muscle scars, in which points it seems to approximate the *M. auricularia* (Speng.) dredged from the neolithic deposits in the bed of the Thames near London. A note on the anatomical features of the animal by Mr. H. H. Bloomer is appended to Mr. Phillips' paper, which is illustrated by three plates from photographs by Mr. A. E. Salisbury.

YIELD OF CONIFERS IN GREAT BRITAIN.—In the Forestry Commission's *Bulletin No. 3* (1920), the "Rate of Growth of Conifers in the British Isles" was dealt with, the information being based on ascertained data and the measurement of sample plots. This Bulletin is now out-of-print and has been revised and re-issued as *Bulletin No. 10*, entitled "Growth and Yield of Conifers in Great Britain." As its title implies, the material here recorded is of a technical character, of interest chiefly to the professional forester, the grower of woods, and the persons who afterwards purchase and make use of the produce. The data of growth are obtained by the periodical and careful measurement of small areas of marked trees termed 'sample plots.' The first selection of such areas requires knowledge and discrimination; since to obtain results of importance areas of different classes of soil at different elevations, exposures, and so forth, require to be selected for each species dealt with. That the considerable amount of investigation work so far carried out has been possible is almost entirely due to the sympathy and cordial assistance extended to the officers of the Commission and others by private land owners, for the majority of the sample plots at present in existence in Great Britain are situated in privately owned woods. A certain amount of new data is included in the revised bulletin, and it may be confidently recommended to the study of all interested in this important matter.

SEED MIXTURES FOR HAY AND GRAZING LAND.—Stapledon and Davies (Welsh Plant Breeding Station, Series H, No. 8, Seasons 1921–1928) deal with various problems of seed mixtures for hay and grazing land, especially in connexion with environment and competition. The effects of soil condition and management have been studied in considerable detail, and yield results of much interest and importance. Comparisons are made of the response from various types of seed mixtures under varying cultural conditions, the practical aspect being kept in view throughout. Special attention has been devoted to colonisation by unsown species. It appears that the trend of such colonisation is determined by the earliness of re-entry of bent grass and Yorkshire fog, and the degree of control which is exercised over these species if they appear immediately and abundantly. Within four years, twenty-four species had made a spontaneous appearance in one of the experimental fields, in addition to others introduced as impurities in the seed sown. Further investigations deal with the influence of inter-specific competition in seed mixtures. This competition is largely determined by the reaction of the individual species to the cultural conditions and management, excessive competition having an adverse effect upon yield. Some species are naturally aggressive in type, but the degree of aggression may be modified by appropriate treatment of the sward. On

the whole, the grasses are aggressive compared to the clovers, chiefly because the grasses are the earlier to start into growth in the spring. Practical application of these experimental results is made in the compounding of "Sensible seed mixtures." The various factors which make for a successful mixture are considered, and details are given of type mixtures suitable for various purposes, subject to modification according to local requirements and conditions.

Sydney and the Blue Mountains.—Three lectures by Dr. W. H. Woolnough, Advising Geologist to the Government of Australia, on the physical features of Sydney and the Blue Mountains, show the excellent physiographic studies in that area which have been stimulated by its many interesting problems. The lectures show the drift of opinion toward the view that faults have been more effective than folds in the formation of the eastern front of the plateau of New South Wales. Both processes have contributed, and at one time a monoclinal fold was regarded as the main movement and the faulting as subordinate. The claim that the Arctic coal seams indicate former tropical conditions where they occur receives no support from Dr. Woolnough; for he declares emphatically that the rich coal seams of the Sydney area are not due to tropical forests, but were laid down under a climate that may have been frigid in severity. The author is perhaps unfortunately conservative in his retention of the term Permo-Carboniferous for the whole of the Coal Measures and associated beds in New South Wales.

Former Glaciation of Kashmir.—A recent *Memoir of the Geological Survey of India* is devoted to a study of the glaciation of the East Lidar Valley in Kashmir by Lieut.-Colonel J. L. Grinlinton (vol. 49, part 2, 1928). The greater part of the memoir is devoted to a careful description of phenomena and is illustrated by a fine set of photographs, sketches, and maps. The probable sequence of events is then deduced. Before the main Lidar valley was cut there existed a high, dissected plateau from which the higher peaks of the present day were carved. This area was first glaciated in what is called the *High Level* epoch of glaciation. A period of deep valley cutting followed, after which came the *Low Level* epoch of glaciation. After the first and maximum extension of the ice downstream, there was a recession during which the ice retreated to the vicinity of the snouts of present-day glaciers. A second epoch of advance and retreat was followed in turn by a third and fourth, leading to the stage of recession represented by the restricted glaciers of the present day. It is noteworthy that an investigation of the former glaciation of the upper Indus by Dainelli also led to the recognition of four successive advances of the ice, but so far no correlation of the respective phases of extension and recession has been attempted.

Survey from Aircraft.—In a pamphlet (*Professional Paper* No. 20, price 2*s*. 6*d*.) published by the Survey of India, Lieut.-Col. C. A. Beazeley describes the methods of reconnaisance survey from aircraft. The system was used by the author in Mesopotamia during the War, and at a later date in that country in filling gaps in mapping where ground survey and air photography were not feasible. No fixed points are needed on the unmapped area, and about a hundred square miles can be sketched in an hour or an hour and a half. The method does not of course produce accurate surveys, but it is valuable when more accurate methods of work are not possible. The chief difficulties in this form of sketching which differentiate it from ground work of a similar nature are, first, the necessity for keeping a constant air speed, or if changes have to be made, recording and allowing for the changes; secondly, the maintenance of a uniform height above the ground; and thirdly, the need of keeping the course. The pamphlet is most practical, and indicates material and apparatus, besides discussing the difficulties of the work. Illustrations, including a specimen air route traverse, are added.

Transparency of Fabrics.—The August issue of the *Journal of Research*, the new periodical in which the Scientific and Technologic Papers of the Bureau of Standards now appear, contains a paper by Messrs. Coblentz, Stair, and Schoffstall on the transmission of visible and of ultra-violet light through fabrics of silk, cotton, linen, wool, and two forms of 'rayon.' A mercury-in-quartz arc supplied the light, which was filtered through a yellow-green glass to give visible light and through a purple glass to give ultra-violet light. Both bleached and black-dyed samples of the same material were examined, the difference giving the transmission of the material itself, apart from that transmitted through the spaces between the threads. There is practically no difference between the transmission of ultra-violet light through white fabrics of the same weight of cotton, linen, and rayon; silk is a little less transparent, and wool about half as transparent as cotton. The transparency of each material is greatly reduced by dyeing it orange, yellow, green, or tan, but for pink the reduction is less. The feathers of fowls transmit ultra-violet light much better than fabrics of the same colour.

The Cosmic Rays.—The two points of outstanding interest discussed by Prof. R. A. Millikan and Dr. G. H. Cameron in their paper in the October issue of the *Physical Review* are the place of origin of the cosmic rays, and the kinetics of their production. As has already been mentioned in Nature (Oct. 6, p. 555), it is believed that the rays are produced in interstellar space; the evidence now adduced in support of this is twofold: first, that there is no marked cosmic radiation from the sun, which is the nearest star, and in many respects a typical one; and secondly, the fact that the energy of the cosmic rays is about one-tenth that of starlight, requires that if the rays were produced in stars they would have to come from their outermost layers, and that the processes responsible for their emission would have to stop rather abruptly at a certain depth, which is extremely unlikely. The kinetic aspect of atom-building is also explained in a very plausible way. It is not necessary to assume, for example, that sixteen protons and eight electrons all meet at one instant and condense into an oxygen nucleus. The protons and electrons can gradually build up into a cluster in which they retain initially their atomic individuality, and then, at a later stage, the cluster can collapse completely to give the new heavy nucleus, with emission of the quantum of radiant energy—the cosmic ray—appropriate to the resulting change in mass. High temperatures must be inimical to the growth of atomic clusters, and it may be that the low temperatures and densities of interstellar space also favour the nuclear condensation, in some way at present unknown. The remainder of the paper is concerned with other aspects of the phenomenon, in particular its thermodynamical significance, the synthesis of the experimental absorption curves, and the question of the bearing of Dr. Aston's accurate determinations of atomic weights upon the possibility of occurrence of radioactive disintegrations. It is noticeable that Prof. Millikan and Dr. Cameron do not consider here why the most favoured condensations of protons and electrons should be those which go to build up the few nuclei which are actually found to constitute the greater part of ponderable matter.

Conference of Australian Physicists.

A CONFERENCE of physicists and astronomers, arranged by members of the Institute of Physics resident in Australia, was held at Canberra on Aug. 15–18, and was attended by nearly forty research workers. This conference arose from a desire to hold more frequent meetings of physicists than are provided by the biennial meetings of the Australian Association for the Advancement of Science. It was felt that the conference had met a real need, and it was decided to hold a similar meeting in Sydney or Melbourne during August 1929. Advantage was also taken of the occasion to hold the fourth general meeting of Australian members of the Institute of Physics, under the chairmanship of Prof. A. D. Ross, of the University of West Australia. Meetings were also held during the conference of the Radio Research Board and the Geophysical Prospecting Committee. The conference was organised by Profs. Laby, Ross, Vonwiller, and Dr. Duffield, while Drs. G. H. Briggs and E. O. Hercus acted as secretaries; arrangements for the next meeting are in the same hands.

A visit was made to the Commonwealth Solar Observatory at Mount Stromlo, ten miles from the Federal capital, where members were welcomed by Dr. and Mrs. Duffield and shown the observatory buildings and equipment, including the Oddy and Farnham telescopes, the latter fitted with photo-electric cells for stellar intensity measurements, and the structural arrangements for the 30-inch reflector, which include the Reynolds dome, a vertical tube 6 ft. in diameter, and a thermally insulated horizontal tunnel in the basement.

The meetings of the Conference were devoted to reports of research work and to the discussion of topics of general interest to members. In opening a discussion on the new quantum theory, Mrs. G. H. Briggs gave an account of Bohr's recent work on the inherent conflict of the ideas of causality and space-time in quantum processes. Mr. H. S. W. Massey referred to the success of the wave mechanics in accounting for the space distribution of scattered electrons and other phenomena. Profs. Madsen and Laby contributed to a discussion on radio research in Australia; emphasis was laid on the need for pure research, and the suggestion was made that some fraction of the broadcasting revenue of a quarter of a million sterling should be set aside for this purpose. Mr. R. O. Cherry described measurements of the relative field strength distribution from the broadcasting station 3LO, Melbourne, found with a portable set over a range of about 50 miles from the aerial. Dr. Bieler, Deputy Director of the Imperial Geophysical Experimental Survey party, gave a description of methods of prospecting which are being tested in the field in selected localities in Australia. Major E. H. Booth, of the University of Sydney, discussed the seismic method of prospecting and described experiments on earth waves detected with a modification of the Tucker microphone. At the conclusion of this discussion a resolution was passed by the Conference urging the executive committee of the Survey to include a study of the seismic method in the scope of the work.

Mr. S. Radcliff showed some exhibits, demonstrating by a new method the appreciable vapour pressure of such substances as sulphur, sealing-wax, and other waxes often used in physical apparatus. Prof. Ross described further work on the magnetic properties of manganese steels, showing that their properties could be attributed to the isomorphism of manganese and gamma iron. The manganese restrains the magnetic transformation on cooling the metal from high to ordinary temperatures, but at liquid air temperature the metastability is wholly or partly destroyed. The alloy may consist chiefly of either austenite, hardenite, troostite, sorbite, or pearlite, according to the heat treatment.

Mr. W. B. Rimmer, assistant director of the observatory, described a spectroscopic examination of type *B* stars, showing that in each spectral subdivision 'line character' is related to absolute magnitude, sharp lines being associated with bright stars. Mr. Allen discussed the measurement of some multiplet lines by the method of photographic spectrophotometry developed at the Utrecht Institute. Mr. J. Nangle, Government Astronomer for New South Wales, described the steady progress towards the completion of the section of the Astrographic Catalogue allotted to the Sydney Observatory. It is hoped that the work will be finished in about ten years. Prof. Bailey (University of Sydney) described experiments on the attachment of electrons to molecules, and Mr. J. Bannon experiments on the motion of electrons in pentane and ethylene. Mr. J. S. Rogers, in the ensuing discussion, stressed the importance in such work of eliminating impurities. Mr. J. Shearer described work carried out with Mr. Bingham and Prof. Laby establishing the reflection of radiation of about 50 A. at grazing angles up to 25° from glass surfaces, and up to 45° for steel and quartz surfaces (NATURE, July 21, p. 96). Prof. Laby communicated a paper by Mr. Webster on X-ray intensity measurement by a photographic method, and one by himself and Mr. Kannuluik on an accurate determination, corrected for the low heat loss, of the thermal and electrical conductivities of a large single crystal of copper at room temperature, and at the temperature of liquid air. Prof. Vonwiller described an interference method of measuring with high accuracy the refractive index of materials such as mica which can be obtained in the form of uniform sheets. Mr. Ray Davis contributed two papers on hydrogen ion concentration, and papers were received from Messrs. Cairns and Johnston of the Watheroo Magnetic Observatory.

Some Band and Emission Spectra.[1]

R. C. JOHNSON.—The band spectra of the alkaline earth halides. (1) CaF, SrF. A continuation and extension of theoretical work done recently on these band spectra by Meckel. A complete quantum analysis of the gross structure of the whole of the bands has been made, and for this purpose a remeasurement of some 250 of the heads under high dispersion was undertaken.

The molecules CaF and SrF give rise to at least three band systems which are analogous in almost every respect. These are assigned to the electron transitions $3\,^2S \longrightarrow 1\,^2S$, $2\,^2S \longrightarrow 1\,^2S$, $2\,^2P \longrightarrow 1\,^2S$. The vibrational constants of the molecules in these various states have been evaluated. Many unusual features found in these band spectra, such as the fewness of the sequences and their exceptional length, are attributed to the smallness of the variation of these vibrational constants with electronic state. Among the unusual features also observed and discussed are

[1] Abstracts of papers read before the Royal Society on Nov. 1.

(a) the occurrence of strong Q branches in ${}^2S \longrightarrow {}^2S$ transitions, and (b) a definite discrepancy in $f(n'')$ as evaluated from the ${}^2S \longrightarrow {}^2S$ and ${}^2P \longrightarrow {}^2S$ systems.

(2) BaF, MgF. A quantum analysis is made of the gross structure of the band spectra of the molecules. In the case of the barium fluoride bands, new measurements of the heads have been made, from plates taken in the first order of a 21-ft. grating. The familiar BaF bands in the green region are believed to constitute two systems attributed to the electron transitions $2\,{}^2S \longrightarrow 1\,{}^2S$, and $3\,{}^2D \longrightarrow 1\,{}^2S$. A number of bands measured by George, and attributed by him to BaO, have been analysed and found to have their final state in common with the above BaF systems, thus proving their fluoride origin. This system is believed to be due to $2\,{}^2D \longrightarrow 1\,{}^2S$. These suggested transitions of the type ${}^2D \longrightarrow {}^2S$, which are believed to be new to band spectra, are discussed. The absence of the transition $2\,{}^2P \longrightarrow 1\,{}^2S$ from the recorded data of the BaF molecule is noteworthy.

The recorded emission bands of MgF constitute a $2\,{}^2P \longrightarrow 1\,{}^2S$ system, in which $\Delta 2\,{}^2P = 18{\cdot}6\,\nu$. The vibrational constants of these various states of both the BaF and MgF molecules are given.

J. M. WALTER AND S. BARRATT.—The band spectra associated with zinc, cadmium, and mercury. The majority of these supposed band absorption spectra, and one band system previously attributed to mercury, would appear to be oxide and chloride spectra. In the present experiments the only bands found which can be attributed to zinc and cadmium themselves, are two weak and diffuse bands, one for each metal. The absorption spectrum of mercury, however, is much richer, and there is no doubt that mercury vapour contains diatomic molecules. The bromides of the three metals, together with the iodide of cadmium, all yield absorption band systems analogous to the chloride bands.

W. JEVONS.—Observations in connexion with the band systems of the fluorides of beryllium and magnesium. The vibrational analyses of the band-head data for the BeF and MgF doublet systems lead to the following interpretations of the heads in each band, those in brackets not having yet been detected. In BeF: R_2, R_1, Q_2, (Q_1) with a doublet separation of the order $R_2 - R_1 = 3$ cm.$^{-1}$, rather than R_2, Q_2 (R_1), Q_1 with a separation $Q_2 - Q_1 = 35$ cm.$^{-1}$ as hitherto assumed. In MgF: P_1, Q_1, (P_2), Q_2 with an electronic doublet separation $Q_2 - Q_1 = 5{\cdot}5$ cm.$^{-1}$, not 22 cm.$^{-1}$ as hitherto given. With these interpretations there is now a continuous increase of the separation of the system-origins of the doublet systems of the alkaline earth fluorides from beryllium to barium fluorides.

With beryllium oxide in the carbon arc in air, conditions may be so arranged as to obtain in the outer flame either (a) the fluoride system strong with the oxide system relatively weak, or (b) the oxide system strong with scarcely a trace of the fluoride system. In condition (b) the ultra-violet region $\lambda 3500 - \lambda 2900$ (where the fluoride system would occur if developed) is occupied by a new set of bands, which, like the BeF and BeO bands, are degraded towards the red.

A similar result is obtained, though less satisfactorily, with other beryllium salts. The new bands are less regularly distributed than any bands of diatomic molecules, and are due either to BeF_2 or to an oxide of beryllium. No bands due to the chloride and no further bands of the fluoride have been found.

The data of the BeO band-system are extended by the recognition of a violet sequence $n'' - n' = -2$, not hitherto observed on account of the $\lambda 4216$ sequence of CN and strong metallic lines.

W. E. CURTIS AND A. HARVEY.—The structure of the band spectrum of helium (5). The details and analysis of five new He_2 bands are given. One of these is a weak vibrational band associated with the known band near $\lambda 5730$ $(3D \longrightarrow 2P$ of ${}_o He_2)$. Another is the ${}_p He_2$ counterpart of the ${}_o He_2$ band designated $3X \longrightarrow 2P$, and described in the preceding paper of this series. The remaining three have $2P$ as the final electronic level and a new type of level (Z) as initial. It is rotationally single, like S and X, but the rotation terms cannot be represented by the usual type of formula, nor are the relative intensities of the branches at all similar to those in other bands.

In consequence of the abnormal character of the initial level the appearance of the $Z \longrightarrow P$ bands is very peculiar; the wave-numbers of the R branch, for example, decrease continuously with increase of rotational quantum number, thus giving it the appearance of a P branch. Two perturbations are recorded in these bands, one a large displacement, and the other a splitting into two components of about equal intensity. The Zeeman effect has already been found to be very unusual in magnitude and character for the band $4Z \longrightarrow 2P$.

The X and Z levels are clearly additional to the ordinary atomic system of levels, and the evidence leads to a tentative identification of them with certain new types predicted by Hund for diatomic molecules, but not hitherto definitely established by observation. Although the chief properties of the new bands may readily be accounted for on this view, several unexplained peculiarities remain, such as the absence of Q branches in $X \longrightarrow P$ transitions, and the relative intensities of the branches in $Z \longrightarrow P$ transitions.

J. C. MCLENNAN, R. RUEDY, AND A. C. BURTON.—An investigation of the absorption spectra of water and ice with reference to the spectra of the major planets. In this investigation the absorption spectra of columns of water of 4 metres and of 21·5 metres length were photographed. Absorption spectra were also obtained with lengths of ice up to 14 metres. Three absorption bands were obtained with water in the infra-red region that would be identified with bands in the spectra of the major planets, and could be taken to indicate the existence of water about these planets not in the form of vapour or ice, but in the liquid state. The absorption in the green shown by planetary spectra cannot be attributed to water, and search for it is being made with certain other liquefied gases.

J. C. MCLENNAN AND A. M. I. A. W. DURNFORD.—The Zeeman effect for the spectrum of tantalum. In all, some fifty-five Zeeman patterns were secured for wave-lengths of tantalum between $\lambda 5548$ and $\lambda 6700$ A. These include practically all the strong arc wave-lengths. A concave grating of 3 metres radius was employed that gave a dispersion for the second order spectrum of 2·6 A. per mm. over the region examined. The light source consisted of a modified form of vacuum arc in a chamber that formed an integral part of the electromagnet. This latter was of the Du Bois type, and a field strength of 21,500 gauss was used.

J. C. MCLENNAN, H. C. H. IRETON, AND E. W. SAMSON.—On the luminescence in solid nitrogen under cathode ray bombardment. With spectrographs of high-light power, the spectrum of luminescent solid nitrogen was photographed from $\lambda 2000$ up to $\lambda 8600$ A. In addition to the bands at $\lambda\lambda 5945$, 5609, and 5230 A. formerly observed, a strong band was found at $\lambda 8535$ A., one at $\lambda 6725$ A., one at $\lambda 6400$ A., and a faint narrow one at $\lambda 6187$ A. in the long wave-length region. Two series of bands were observed with short wave-length region with nearly constant wave-

umber differences that were approximately equal to 15 and 175. The bands at λλ5945, 5609, and 5230 A. ere all phosphorescent ones, and the light emitted that orresponded to them was not noticeably polarised.

Decay curves were obtained for the luminosity orresponding to these three bands. In the decay of ne λ5945 A. light, two distinct stages were noted, and in the decay of that corresponding to λ5230 A. three stages were observed. In both cases the phosphorescence was of the 'vanishing type.'

The results of the investigation suggest that hydrogen occluded in minute traces in the solid nitrogen may account for the phosphorescence observed with the latter when subjected to electronic irradiation.

Crystal Structure and Properties.[1]

A. MÜLLER.—A further X-ray investigation of long-chain compounds. The fortunate discovery f a single crystal of a normal hydrocarbon, n-$C_{29}H_{60}$, as made it possible to determine with considerable ccuracy certain details of the structure of a long-chain nolecule. The ratio of the length of the fundamental ub-period of the chain has been measured to 1 part in 000. Various other constants have been less accurtely determined.

Each carbon atom in the chain is known to be ssociated with two hydrogen atoms, with the excepon of each of the end atoms, to which three are ttached, forming methyl groups. If each carbon tom with its two hydrogens be considered as a separte group capable of representation by a single cattering centre, the chain is found to have a regular igzag form with a centre at every corner. The two nd carbons may with very good approximation be aken to be represented by the two ends of the zigzag. he centres therefore lie on two parallel lines, 15 on ne, 14 on the other. The ratio of the distance between wo consecutive centres on the same line to the length f the chain, the sub-period of the chain, is 0·03286 ± ·00002. As the length of the chain is 77·2 A., this istance is 2·53$_7$ A., which is, within the limits of xperimental error, the distance between two correponding atoms in diamond. The closest distance etween two lines of centres belonging to different nolecules is 3·7 A. Thus there is room for the replacenent of hydrogens by oxygens, and in fact it is found hat the dimensions (though not the intensities of the eflections) of the ketone $C_{30}H_{60}O$ and the hydroarbon $C_{30}H_{62}$ are identical.

The area of cross section of the molecule is found to e 18·5 × 10^{-16} sq. cm., a result in good agreement with he values already determined in the case of other ingle crystals of long-chain compounds.

I. E. KNAGGS.—The form of the central carbon atom n pentaerythritol tetra-acetate as shown by X-ray rystal analysis. The X-ray examination of these crystals was undertaken with the view of studying the behaviour of the central carbon atom in a compound in which the four carbon valencies are satisfied by like groups. Pentaerythritol tetra-acetate crystallises in the tetragonal bipyramidal class; the crystals are built on the Bravais lattice, Γt and the space group C_{4h}^{4}; there are two molecules in the unit cell, which has the dimensions 11·98^2 × 5·47 A.

The molecule possesses a four-fold alternating axis of symmetry, which must pass through the central carbon atom. The central carbon atom itself may be tetrahedral, though some slight departure from true tetrahedral symmetry is possible. A probable structure for the crystals is suggested.

J. E. LENNARD-JONES AND B. M. DENT.—The change in the lattice spacing at a crystal boundary. The contraction of the lattice at the (100) boundary of crystals of the NaCl type is confined almost entirely to the top layer and is of the order of 5 per cent. An upper limit is found for the decrease in the interatomic spacing in the surface layer; this also is of the order of 5 per cent. The surface tension of a number of crystals of the NaCl type is calculated.

N. A. ALSTON AND J. WEST.—The structure of topaz. From a quantitative analysis by X-rays of the structure of topaz, $[Al(F,OH)]_2SiO_4$, it appears that although this crystal is sometimes considered to belong to the orthorhombic pyramidal (polar) class, the structure actually found is holohedral in character.

The chief feature of the structure is the arrangement of the oxygen and fluorine atoms. Regarding these atoms as equal in size, they form a close-packed assemblage which belongs strictly to neither of the two well-known hexagonal and cubic types of close-packing. These two types and the assemblage found in topaz may be conveniently regarded as the simplest examples of the ways in which a series of identical planes, consisting of similar atoms in contact, may be closely stacked together, one on top of the other, so as to form a series of layers in periodic succession.

Some of the more complex structures still awaiting analysis, which, whilst exhibiting certain features characteristic of close packing, belong neither to the hexagonal nor to the cubic type, may actually prove to be based on one of these less simple arrangements. Although in a structure of this kind it is difficult to distinguish between oxygen and fluorine atoms, it is believed that the four atoms which surround tetrahedrally each silicon atom are oxygen, whilst of the six atoms arranged symmetrically about each aluminium atom, four are oxygen and two are fluorine.

J. C. MCLENNAN, R. RUEDY, AND E. COHEN.—The magnetic susceptibility of single crystals of zinc and cadmium. The magnetic constants of single crystals of zinc and cadmium have been determined. For the magnetic susceptibility $\chi_{\parallel}$ (parallel) and $\chi_{\perp}$ (normal) to the hexagonal axis, the results are

Cd . . . . $\chi_{\parallel} = 190 \times 10^{-6}$, $\chi_{\perp} = 145 \times 10^{-6}$.
Zn . . . . $\chi_{\parallel} = 261 \times 10^{-6}$, $\chi_{\perp} = 160 \times 10^{-6}$.

With mercury the results obtained lend support to the view that this metal crystallises in a rhombohedral form.

R. W. JAMES AND G. W. BRINDLEY.—A quantitative study of the reflection of X-rays by sylvine. The variation of the intensity of reflection of X-rays from sylvine with temperature is quantitatively in agreement with the Debye-Waller law from the temperature of liquid air up to about 400° abs. At higher temperatures the decrease of intensity with increasing temperature is much more rapid than the law indicates. The value of the temperature factor based on observations at room temperature and at the temperature of liquid air agrees very well with that calculated by Waller from the elastic constants of the crystal, and also with the value calculated from the Debye-Waller law using the characteristic temperature.

The absolute values of the intensity of reflection are in good agreement with those calculated from the Schrödinger density distribution for K^+ and Cl^- obtained by Hartree's method, if each element of the distribution is assumed to scatter classically, and if, in correcting for temperature, the existence of zero-point energy is assumed.

[1] Abstracts of papers read before the Royal Society on Nov. 1.

Vitamin *A* as an Anti-Infective Agent.

WHEN the fat-soluble vitamins were first differentiated, it was soon recognised that animals maintained on synthetic purified rations deficient in fat-soluble *A* not only ceased to grow after a variable time, but also were very prone to develop various infections. One of the most obvious and common of these was an infection of the conjunctiva, which is known as xerophthalmia; hence the usual signs of vitamin *A* deficiency looked for were cessation of growth and this eye disease. When vitamin *D* was differentiated from vitamin *A*, the question arose as to whether the signs of fat-soluble vitamin deficiency were due to lack of vitamin *A* or vitamin *D*. It was found that both are necessary for proper growth; but except for some recent observations by Goldblatt and Benischek, the relationship between these vitamins and infective processes has not been fully worked out. The results of these authors suggested that vitamin *A* was the more closely related to the prevention of infection.

H. N. Green and E. Mellanby have therefore made a study of the effects upon rats of maintenance upon a diet deficient solely in vitamin *A* (*Brit. Med. Jour.*, p. 691, vol. 2, 1928). The animals were fed a synthetic ration well balanced as regards protein, fat, carbohydrate and salts, and containing vitamin *B* (marmite), vitamin *C* (lemon juice), and vitamin *D* (irradiated ergosterol in the form of 'Radiostol' solution, ½ to 1 drop daily each animal). Some rats were kept on a diet deficient in both vitamins *A* and *D*, whilst another group were given vitamin *A* in the form of dried cabbage (0·5 gm. daily), butter (0·1 gm. daily), or cod-liver oil (5-10 mgm. daily). The results obtained were quite clear-cut. On the diets lacking vitamin *A* the animals lived for 58-169 days; during most of the time they ate their food well and showed moderate growth; during the last week or so of life, however, the appetite failed, weight was lost, and finally death ensued. In almost all these animals (93 in all) some, and generally many, organs were found infected with micro-organisms. The presence of vitamin *D* in the ration made no difference to the results: it appeared, indeed, to hasten the onset of the infection, probably owing to its stimulating effect on growth whereby the stores of vitamin *A* were caused to disappear more rapidly.

In all the animals lack of fat and general visceral atrophy were striking features: in addition, 91 of the 93 showed evidence of infection in some part of the body. Only 38 per cent developed the characteristic lesion of xerophthalmia in this series, other types of infection having been found more commonly: thus 72 to 90 per cent, according to the period of survival, showed abscesses at the base of the tongue, in the accessory salivary glands, and 44 per cent or more gave evidence of infection of the urinary tract. Other sites of infection were the intestines (21 per cent), the lungs (9 per cent), and the nasal sinuses or middle ear (20 per cent); once an abscess in the wall of the left ventricle of the heart was seen.

These observations should be contrasted with the results obtained in 50 animals fed on the same diet plus one of the sources of vitamin *A* mentioned above for periods as long as, or longer than, those the deficient rats survived. In none was any signs of bacterial infection observed: three cysts of the liver, of parasitic origin, were noted; otherwise the tissues were perfectly healthy.

It appears, then, that vitamin *A* plays a significant part in maintaining the resistance of the body to infection, and it is probably more directly related to resistance to infection than any other known food factor. If these results can be applied to man, it appears possible that various infections may be ultimately traced to deficiency of vitamin *A* in the diet. It is known the xerophthalmia occurs in man in conditions of deficient intake of fat-soluble vitamins, but the condition is rare, and only occasionally is the deficiency so gross as to lead to its appearance. More important is the possible relationship between inflammatory processes of the nasal sinuses, middle ear disease, and pneumonia, and vitamin *A* deficiency. At present it is impossible to be certain about such a relationship, but it is generally agreed that the usual sources of vitamin *A*, milk, butter, eggs, and green vegetables often find little place in a modern dietary. Making due allowance for differences in requirement between rat and man, but remembering that xerophthalmia can occur in both under similar types of nutritional deficiency, we might expect that a more adequate consumption of vitamin *A* by human beings might decrease the incidence of at any rate some of the commoner suppurative processes. The possibility of a dietary deficiency should also be borne in mind in their treatment.

Condition of Plaice in the North Sea.

IN *Min. Agric. and Fish., Fishery Investigations*, Ser. 2, vol. 10, No. 3, 1927, Miss D. E. Thursby-Pelham reports on the condition of the plaice stock in the North Sea in 1925 as compared with 1923, and on the changes that took place in 1924 and 1925. The investigations by the Ministry have been continued year by year and tend to indicate that the plaice stock, which showed a marked increase both in size-distribution and abundance immediately after the War, and such a rapid decline under intense fishing in succeeding years, is still in a condition of flux.

The landings of plaice during 1923, 1924, and 1925 were below those of any previous year since the inception of reliable statistics in 1906. In 1925 the position with regard to the actual quantity landed, and abundance as evidenced by the catch per 100 hours' fishing, was better than in the two previous years. Less fishing, moreover, was carried on during that year, and therefore the effect of the increased abundance on the landings was not so marked as would have been the case if fishing had been carried on with its former intensity. This improvement, however, was entirely due to increased quantities of 'small' plaice, since both 'large' and 'medium' continued to decline both in actual quantities landed and in abundance.

The decline in size as evidenced by the statistical categories has been continuous since 1922 from year to year, but was not so marked during the year March 1925–February 1926 as in previous years. The evidence may indicate that the size-distribution of the plaice stock is becoming stabilised.

The question arises as to the extent to which the small size of the plaice caught may be attributed to over-feeding, and to what degree it is due to natural fluctuations. It would appear, from the very limited available evidence, that the great abundance of 'small' in 1925 was due to natural fluctuations. The same is true to some extent with regard to the scarcity of 'medium,' but it would seem that, in addition, the heavy fishing since the War has played a considerable part in the decline in abundance of this category. Miss Pelham expresses the opinion that the extent of the effect of fishing should be more easily adjudged in and after 1926, when it will be seen whether the very abundant 'small' of the last few years have remained uncaught in sufficient quantities to augment the 'medium' and the 'large.'

University and Educational Intelligence.

CAMBRIDGE.—The annual report of the Board of esearch Studies shows a further slight increase in the imber of students working for research degrees, the crease coming mainly from the graduates of the Uni- ersity of Cambridge itself. Trinity and Emmanuel olleges lead the field in the number of such students, ith Newnham, St. John's, Gonville and Caius, and hrist's Colleges coming next on the list. On the whole, iere is a tendency for the numbers to increase in l the colleges. The subjects of study most pro- inently represented are physics, mathematics, hysical chemistry, botany, English, history, agri- ulture, and biochemistry. More than one-third of ie students are now Cambridge graduates, the reater number from outside coming from the uni- ersities of the United States, Australia, Canada, Vales, and London.

Dr. W. E. Dixon, Downing College, has been ppointed assessor to the Regius professor of physic. . W. Brunyate, Trinity College, has been nominated the Choate memorial fellowship at Harvard Uni- ersity, and T. Smith, Trinity College, to the Jane Eliza Procter visiting fellowship at Princeton Uni- ersity. W. H. McCrea, Trinity College, has been lected to an Isaac Newton studentship in astronomy nd optics.

EDINBURGH.—The University Court, at its meeting n Oct. 29, received with gratification intimation of a ift of £5000 from Sir Leybourne Davidson, of Huntly odge, for the foundation and endowment of a fellow- hip for the encouragement and promotion of research n bacteriology and immunology.

The Court expressed its thanks for a gift by Sir John ilmour, Rector of the University, to the Department f Research in Animal Breeding, of plaster casts of two lydesdale horses which were used as foundation stock n the Montrave stud. These models are of great nterest in showing the type from which the modern lydesdale has sprung.

The Court confirmed the following appointments: Mr. Harold S. Ruse, to be lecturer in mathematics; Mr. James Paton, to be lecturer in natural philosophy Mr. W. G. Millar, to be lecturer in pathology; and Mr. Alfred T. Haynes, to be lecturer in actuarial mathematics.

GLASGOW.—A gift of £10,000 from Mr. William Teacher has enabled the University to establish an en- dowed lectureship in bacteriology in connexion with the Royal Infirmary. The lecturer will at the same time hold the post of bacteriologist to the Hospital.

Another gift, of approximately £15,000, has been made to the University by Sir Frederick Gardiner and his brother William for the purpose of establishing a research lectureship in the pathology of children's diseases at the Royal Hospital for Sick Children. The lecturer will also be appointed pathologist to the Hospital. The Gardiner brothers have already founded and endowed three chairs in the University the professorships of organic chemistry, of physiological chemistry, and of bacteriology.

LONDON.—The following doctorates have been conferred:—D.Sc. in Botany: Mr. W. J. Dowson (Imperial College—Royal College of Science), for a thesis entitled "(1) On the Stem Rot or Wilt Disease of Carnations; (2) On an extraordinary *Botrytis* causing a Disease of Narcissus Leaves; (3) A Blossom Wilt and Stem Rot of Cultivated Antirrhinums and Schizanthus due to *Sclerotinia slerotiorum* (lib. Massee (4) On Core Rot and Premature Fall o Apples associated with *Sclerotinia Fructigena*; (5) A Die-back of Rambler Roses due to *Gnomonia Rubi* Rehm"; D.Sc. in Chemistry: Mr. Ahmad Zaki (University College), for a thesis entitled "Benzoic Esters and Electronic Affinities of Radicles"; D.Sc. in Geology: Mr. K. W. Earle (University College), for a thesis entitled "The Geology of the British Virgin Islands, and other West Indian Studies"; D.Sc. in Chemistry: Mr. L. L. Bircum- sha, for a thesis entitled "The Surface Tension of Liquid Metals," and other papers; Mr. B. M. Cavanagh, for a thesis entitled "On the Interpre- tation of the Thermodynamic Properties of Solutions" and "On New Principles and Methods of Potentio- metric Titration"; and Dr. F. H. Constable, for a thesis entitled "A New Interference Method of Measuring the Surface Area of Film Catalysts," and other papers.

The Laura de Saliceto Studentship, of the value of £150, has been awarded for 1929 to Dr. A. F. Watson, for the purpose of continuing investigations on a detailed study of dietary and other factors contri- buting to the genesis and development of experi- mentally induced tumours in animals.

MR. F. G. G. A. MARRAINE has been appointed to the post of lecturer and demonstrator at Faraday House Electrical Engineering College.

SIR DUGALD CLERK has accepted the chairmanship of a committee appointed by the President of the Board of Education to advise as to the scope and methods of the Board's inquiry into technical educa- tion for the engineering industry. Mr. H. B. Wallis will act as secretary to the committee, and all com- munications should be addressed to him at the Office of the Board of Education, King Charles Street, Whitehall, London, S.W.1.

THE new buildings for the Departments of Physics and Chemistry of University College, Cardiff, have been completed and the transference of classes and equipment to the new quarters is practically accom- plished. A new building to accommodate the Ad- visory and Research Department in Agriculture has also been completed and will be in occupation during the present term. Dr. Norman Thomas has been appointed professor of engineering in succession to Prof. A. J. Sutton Pippard (resigned). In the Welsh National School of Medicine, Prof. J. H. Dible has been appointed professor of pathology and bacteriology in succession to Prof. E. H. Kettle (resigned).

THE British Federation of University Women, Crosby Hall, Chelsea, S.W.3, makes the following announcement with reference to offers of travelling fellowships for women for the academic year 1929–30, the latest date for the receipt of applications from British women graduates resident in Great Britain being given in brackets: An international fellowship of the value of 1500 dollars, for research in any country other than the holder's own, offered by the American Association of University Women (Nov. 26). An in- ternational junior fellowship of the value of £250, for research in a country other than the holder's own, in language, history, archæology, philosophy, and theology, offered by the International Federation of University Women (Jan. 31, 1929). A vacation scholarship of the value of 2000 French francs, for research or other advanced study in France, offered by the French Association of University Women (Jan. 31, 1929). Application forms and regulations may be obtained from the Secretary, British Federa- tion of University Women, as above.

Calendar of Customs and Festivals.

November 11.

ST. MARTIN. "The Glory of Gaul." Bishop of Tours.—A native of Sabaria in Upper Pannonia, born in 317, the son of a military tribune and himself a soldier. He is best known for his charity to a beggar, to whom he gave half his cloak, clothed in which Christ appeared to him in a vision the following night. On entering the Church he became a hermit, when he restored one of his disciples to life, and also a slave who had been hanged. On one occasion the ghost of a reputed martyr, whose chapel and altar were held in great repute by the people, appeared to the saint and revealed that he had been no holy man, but a robber, executed for his crimes.

As Bishop of Tours, St. Martin was active in extirpating the pagan temples and sacred groves in which his diocese abounded. Once, at the request of pagans, he allowed himself to be bound to a sacred pine while it was being felled, but on his making the sign of the cross it fell so as not to crush him. The pagan beliefs of his diocese must also be held responsible for St. Martin's activity in casting out devils, though, curiously enough, he confessed that this achievement became increasingly difficult as he grew old.

MARTINMAS; MARTINALIA.—On the Continent the goose killed in England at Michaelmas was sacrificed at Martinmas, the explanatory legend being that St. Martin, being unwilling to accept the bishopric of Tours, hid himself from the diocesan electors, but was discovered by a goose. In the ancient clog calendars the day was marked with a goose.

As the pastoral peoples brought in the flocks and herds from the grazing grounds to their winter quarters, the opportunity was taken to weed out superfluous head, sacrificing some of the increase to the gods, and salting down provision for the winter. This practice survived in the custom of a feast celebrated at Martinmas over the greater part of Christendom. In vine countries the new wine was then tasted. In Scotland and the north of England a fat ox was called *Mart*, a name said to be derived from Martinmas, as the time when beeves, swine, etc., were killed for winter store. The English were notorious as meat eaters among European nations in the Middle Ages, and the extent to which the people were dependent on salted meat in the winter months must be held the ground for the belief that they were peculiarly subject to scurvy. Several passages are quoted by Brand in reference to Martlemas beef, that is, beef dried in the chimney like bacon.

In Scotland as late as the middle of the eighteenth century Martinmas continued to be the recognised date for beginning to make provision for the winter. In Forfarshire, it was recorded that twenty-four beeves were killed in a week. In Wigton, the poorer people eat no beef and little mutton—a sheep or two killed at Martinmas and salted down for winter.

In Northumberland, families who clubbed together to buy a beast for the feast were known as a 'mart.' The entrails of the animal were stuffed with a kind of pudding meat, and known as black puddings. These were sent as presents. A similar entertainment in Germany was known as the 'feast of sausages.' Dishes of entrails accompanied by liberal potations were traditional in Franconia.

In parts of Ireland in the villages every family used to kill an animal of some kind, those rich enough a cow or sheep, even the poorest a hen or cock, and sprinkle the threshold and the four corners of the house with the blood. This excluded all evil spirits from the house until the following Martinmas. Persons sprinkled with the blood were also freed from evil influences.

The close association of ecclesiastical and popular custom is seen in the practice recorded in the North Riding of Yorkshire, in which a party of singers, mostly women, made a peregrination around the neighbouring villages, carrying a small waxen image of Christ adorned with evergreens, while they sang a nativity hymn. This continued until 'good living' began on Christmas Eve, when every housewife produced a cheese preserved for the festival, on which, before any part was tasted, the mark of the cross was made with a sharp knife.

In the Roman Calendar, Martinmas superseded the Vinalia, the feast of the new wine. As a further indication of the close connexion between Martinmas and the wine feast may be mentioned the practice of boys placing out jars of water in the belief that it would be turned into wine in the course of the night. Usually the parents looked to it that they were not disappointed.

November 13.

ST. BRICE'S DAY.—Down to a late period an observance known as 'bull-running' was observed on this day at Stamford. The butchers of the town provided a bull at their own charges, which was placed overnight in a stable belonging to the Alderman. On the following morning the town bellman published a proclamation that all shut up their shop doors and gates, that none do any violence to strangers, a guard being appointed to escort them through the town, and that none have any iron on their bull clubs. The bull was then turned loose into a street stopped at each end, and pursued by all the inhabitants and their dogs. Finally, the bull was driven to the bridge, where he was forced into the river. At nightfall he was slaughtered and the flesh sold at a low price to the poor. At one time a female clad in blue and decked with ribbons was a part of the celebration. Its traditional origin in a fight between two bulls checked by William Earl of Warren, connects it with a meadow, the 'bull meadow,' in which the town of Stamford holds certain traditional rights.

It may be noted that in the Manor of Whitlesea, in Cambridgeshire, there is a custom for the inhabitants to choose on the Sunday next after Martinmas two persons called stovers, who oversee public business and provide a common bull, in consideration whereof they enjoyed a certain pasture called 'bull-grass.'

November 17.

ST. HUGH, BISHOP OF LINCOLN, A.D. 1200.—Gunpowder Plot, though the best known, is not the earliest political event by which the November fires have been adopted. In the twelfth year of Queen Elizabeth's reign, her accession to the throne was celebrated in an outburst of Protestant enthusiasm on Nov. 17, with a procession, bonfires, and illuminations in the city of London. The celebration was continued regularly until late in the eighteenth century. The principal figure in the procession was an effigy of the Pope, who was accompanied by his counsellor, a person dressed as the devil, who embraced him and whispered to him as the procession moved on. In the reign of Queen Anne the figure of the Pretender was added. Pope, devil, and Pretender were all burnt in effigy at the Inner Temple gates after the statue of Queen Elizabeth on Temple Bar, wreathed in laurel for the occasion, had been visited.

Societies and Academies.

LONDON.

Royal Society, Nov. 1.—G. D. Bengough, J. M. Stuart, and A. R. Lee: The theory of metallic cor- ɔsion in the light of quantitative measurements (2). 'orms of corrosion-time curves for zinc in potassium hloride solutions in the presence of oxygen have been efined at 25° C. and 760 mm. over the range $N/20,000$ ɔ N. Each curve has a short initial branch, concave pwards. With solutions as weak as $N/10,000$, dis- laced hydrogen may either appear as gas or be oxid- ɪed. In $N/10$ solutions, nearly 15 per cent of the total orrosion is associated with gas evolution. The curves ɔr corrosion due to oxygen absorption are exponential 1 weak solutions (up to about $N/5000$), and straight nes steeply inclined to the horizontal in stronger olutions (up to N at least). The controlling factors re concentrations of chlorine ions for exponential urves and rate of oxygen supply for straight lines. 'he final amount of corrosion is independent of oxygen upply and is determined by concentration of chlorine ɔns, and rate of their withdrawal from solution.

C. V. Raman and K. S. Krishnan: The production f new radiations by light scattering. Part 1. When ny transparent medium is irradiated by mono- hromatic light, the radiations scattered by the mole- ules contain spectral lines of modified frequencies, he difference between incident and scattered fre- uencies corresponding to a characteristic infra-red 'equency of the molecule. Most of the modified lines re of smaller frequency than the exciting line. There re some relatively feeble lines the frequencies of hich exceed the frequency of the exciting line by an ıfra-red frequency of the molecule. In these lines e have for the first time direct experimental proof of *nduced emission* (or negative absorption) of radia- ion by molecules. The scattered lines are sometimes ccompanied by a nebulosity or continuous spectrum, xtending unsymmetrically on the two sides. The odified radiations scattered at 90° exhibit striking olarisation, the degree of polarisation being different or lines corresponding to different frequency shifts.

P. E. Shaw: Tribo-electricity and friction. (4) 'ribo-electric charges arise by the clash of solid sur- aces as when fine particles are blown at high speed hrough a tube or into a large vessel. With metal par- icles and surfaces, when the particles and surfaces ire *unlike* (for example, zinc filings and copper sur- ace), the amount of charge is closely proportioned to he well-known electrochemical values. When the ɔarticles and surface are *alike* (for example, zinc ilings and zinc surface), no charges would be expected, ɔut they invariably arise. The general law is that charges arise by the clash of solids, like or unlike, netallic or non-metallic.

E. B. Moullin: An ampere meter for measuring urrents of very high frequency. A new form of ammeter has been designed primarily for measuring alternating currents of extremely high frequency, such as 3×10^7 cycles per second. The calibration of any instrument must be affected by frequency, and this instrument has been arranged to have a geometrical form for which the correcting factor can be calculated. The system consists of two parallel circular cylinders mounted inside, and parallel to the axis of, a circular screen tube. The two circular cylinders are in elec- trical connexion at one end, and one of them is mounted on an elastic support which permits that cylinder to move parallel to itself. The current to be measured flows along one cylinder and returns by the other, and the consequent repulsive force between them causes the elastic support to yield proportionately to the root mean square value of the current. The move- ment is observed by means of a suitably arranged optical microscope.

S. Goldstein: The influence of the earth's magnetic field on electric transmission in the upper atmosphere. A detailed study has been made of the magneto-ionic theory of the propagation of radio waves in the upper atmosphere. Mathematical formulæ are given for the polarisation and wave-velocity of a plane wave-train in an ionised medium with imposed magnetic field oblique to the direction of propagation and the results applied to calculate the polarisation of downcoming radio waves. The agreement with experiment is satisfactory.

S. R. Milner: The 'action' of an electromagnetic field. The electromagnetic equations in their usual form express the rates of variation of the field vectors along the time axis of an arbitrary observer. The consideration of the rates of variation along other lines in space-time, in particular along the lines which mark out the simplest structure of the field, leads to the equally legitimate conception of the field as being in motion. In this way expressions for the Hamiltonian and Eulerian *actions* of the field are obtained which form strict equivalents to those for the actions of a dynamical system.

H. A. Wilson: Chemical equilibrium in the vapour of a mixture of paraffins and unsaturated hydro- carbons. The thermodynamical method previously used (*Proc. Roy. Soc.* A, vol. 116, p. 501; 1927) to calculate the equilibrium composition of a mixture of paraffins is applied to a mixture of paraffins and unsaturated hydrocarbons. An expression for the fraction of the total pressure due to unsaturated hydrocarbons, in equilibrium, is obtained. This fraction diminishes as the pressure is increased, in- creases as the temperature increases, and cannot be greater than one-half when the vapour is in contact with liquid.

E. H. Gowan: The effect of ozone on the tempera- ture of the upper atmosphere. An equilibrium equa- tion using water vapour and ozone is set up and the steps of a solution by successive approximations are given. The theoretical consideration of the radiative equilibrium leads to a warm region agreeing very well as regards both temperature and height with the results of indirect observations.

H. Gregory and C. T. Archer: The thermal conduc- tivities of carbon monoxide and nitrous oxide. An experimental determination was carried out. A com- parison is given of some of the physical properties of these gases with those of gases of equal molecular weight. While the viscosities of carbon monoxide and nitrogen, and of nitrous oxide and carbon dioxide, are equal, as suggested by the kinetic theory of gases, a marked difference exists in the values of the thermal conductivities of the gases considered.

N. K. Adam and G. Jessop: The structure of thin films, Part 12. The action of cholesterol in reducing the area of certain expanded films to that of con- densed films, discovered by Leathes in 1923, is further investigated. It is probably due to mechanical obstruction of the tilting oscillations of the molecules in the expanded state, by the bulky and massive cholesterol molecules, not to any special attraction between the cholesterol and the smaller molecules. The condensing action can be imitated by other very large molecules, the effects of which are not, however, precisely similar. An attempt is made to correlate the minor differences in condensing effect of various molecules with their solidity at various points, as indicated by their constitutional formulæ.

W. A. Bone, L. Horton, and L. J. Tei: Researches on the chemistry of coal (5). Further investigations have

been carried out upon the benzene pressure-extraction of various types of coals with the view of arriving at some understanding of the origin and development during the 'maturing' process of the constituents which are principally responsible for the coking propensities of bituminous coals. The coals examined in detail included (1) the Morwell brown-coal occurring in Victoria in Australia, (2) a series of lignitic and other coals from the Western Canadian Coalfield (Saskatchewan and Alberta), and (3) three bituminous coals (two of British and the third of South African origin). Incidentally, it is shown that the substances removed by the process are not produced by thermal decomposition (in the sense of any real breakdown of the coal substance) but are pre-existent in it, either as such, or in some loose molecular association with the coal complex, more probably the latter. The residues from benzene pressure-extraction are always quite devoid of coking propensities. The general effect of 'maturing' has been progressively to diminish the oxygen contents of the substances comprised in each and all the various fractions of the benzene-pressure extracts as well as of the benzene extracted residue.

H. L. Callendar: Steam tables and equations extended by direct experiment to 4000 lb./sq. in. and 400° C. A steady flow method was devised, with a jacketed condenser (*Phil. Trans.*, 1912) capable of reading to 1 in 5000 of the total heat of either water or steam at pressures up to 4000 lb./sq. in., and independent of the thermal capacity of the apparatus at high temperatures. The work was interrupted by the War, but has recently been completed with the assistance of the British Electrical and Allied Industries Research Association. The results for the total heat of water verify the thermodynamic formula at saturation (*Phil. Trans.*, 1902) with great precision up to the critical point. Those for steam show complete agreement with the expression $c/(1-Z^2)$ for the co-aggregation volume, but cannot be reconciled with the van der Waals' theory of the critical state. By combining the observations on the volumes and the total heats, it is easy to deduce the corresponding expressions for the entropy and the saturation pressure. The saturation lines for water and steam could be traced by experiment beyond the critical point up to 380° C. The observations agree all the way from 0° to 380° C. with the theoretical formula, and afford independent verification of the whole system of equations. No change is required in the original value of c representing the first term in the series, and the results appear to be strongly in favour of the co-aggregation theory.

W. R. C. Coode-Adams: The refractive index of quartz. In a previous paper (*Proc. Roy. Soc.* A, vol. 117; 1927) an equation was produced connecting the refractive index of quartz and the wave-length for the ordinary ray. This was of the Ketteler-Helmholtz type and derived its constants partly from previous work on the optical rotatory power. The other constants were solved taking known values for the refractive index. In the present paper the same is attempted for the extraordinary ray.

ROME.

Royal National Academy of the Lincei, June 1.—**G. Giorgi**: Factors and indices in linear groups and in normal groups of operations.—**Q. Majorana**: Further consideration of the photo-electric phenomenon of the audion. Substances other than the cupric oxide or cuprite covering the wire leading to the grid are capable of producing effects analogous to the photo-electric phenomenon realised when a strong beam of light, periodically interrupted, falls on a sensitive audion connected with an amplifying system. Such are freshly prepared thallium sulphide (probably an oxysulphide), molybdenite, argentite, silver sulphide prepared artificially, and light-sensitive selenium. The phenomenon appears to be a perturbation, electrical in character, caused by the arrival of the light, but not corresponding with external liberation of electrons. It depends on the nature of the substances used, which all exhibit semi-conductivity, or, as with silver sulphide, distinct electrolytic conductivity.—**P. Vinassa**: Symmetrical electronyls and monatomic molecules.—**N. Parravano** and **V. Montoro**: 'Blanc' alumina. Alumina prepared by decomposition of aluminium chloride at a low temperature is crystalline, trigonal, of low density, and possessed of high adsorptive powers. At about 650° it undergoes an exothermic transformation owing to contraction in the volume of the unit cell. The name 'Blanc' alumina, after Prof. G. A. Blanc, is suggested for this material. —**L. Petri**: Gurwitsch's mitogenetic radiations.—**A. Perroncito**: Extirpation of the liver (two new methods).—**A. Palatini**: The varieties V_n which contain a constant vectorial field.—**R. Caccioppoli**: The infinitesimal character of quadrable surfaces.—**U. Crudeli**: Saint-Venant's conditions relative to the deformations of natural media.—**U. Barbieri**: Astronomical-geodetic station on Monte Colma di Mombarone, August 1927.—**G. Gentile**: The intensified terms of calcium.—**F. Rasetti**: Calculation of the terms M by means of the statistical potential of the atom.—**E. Segrè** and **E. Amaldi**: The anomalous dispersion of mercury and of lithium. Results are given of measurements of the intensities of certain absorption lines of lithium and mercury. The ratio between the numbers of dispersion electrons for the lithium lines 6708 A. and 3232 A. is found to have the value 135 (± 20 per cent). No absolute measurements were possible with the mercury lines.—**F. de Carli** and **P. Agostini**: The double carbonate of copper and sodium. Hydrated copper sodium carbonate, $Na_2CO_3.CuCO_3.3H_2O$, may be converted into the corresponding anhydrous compound by heating it in a current of carbon dioxide. The anhydrous salt, which is pale blue, is unstable in the air and readily absorbs moisture to give the hydrate. The heating curve shows that the absorption of heat corresponding with the loss of carbon dioxide occurs between 220° and 230°. The thermal changes accompanying the decomposition of the double carbonate and of copper carbonate are given by the equations $Na_2CO_3.CuCO_3$ (sol.) $= Na_2CO_3$ (sol.) $+ CuCO_3$ (sol.) $+ 10 \cdot 330$ Cal. and $CuCO_3$ (sol.) $=$ CuO (sol.) $+ CO_2$ (gas) $+ 0 \cdot 995$ Cal.; for the heat of formation of cupric carbonate from its elements, $Cu + C + 1\frac{1}{2}O_2 = CuCO_3$ (sol.) $+ 138 \cdot 345$ Cal.—**S. Berlingozzi**: Chemical constitution and rotatory power (3). The rotatory powers of several acyl-asparagines are compared with the values of the dissociation constants of the acids corresponding with the acyl substituents. The diminution of the value of $(M)_D$ with increase in k is brought out with special clearness in groups of compounds containing acyl groups of analogous structure. This relationship is complete with the ortho and meta compounds, and in the more numerous para compounds examined the only exception is anisoylasparagine, which has a lower molecular rotation than would be expected from the dissociation constant of anisic acid.—**P. Misciattelli**: Analysis of a radioactive pyromorphite from Gennammari (Sardinia). The slight radioactivity of this mineral is regarded as due to the presence of small proportions of radium introduced by water, which extracts it from a deep-lying uranium mineral.—**L. Bucciante**: Duration of the kinetic and interkinetic periods in the embryos of chickens incubated at various temperatures. The increased growth in the embryos of chickens produced by increase in the temperature of

incubation is the result of sensibly equal influences exerted on the kinesis and interkinesis.—O. M. Olivo and E. de Lorenzi : The duration of interkinesis in cells cultivated *in vitro*.—B. Monterosso : Cirrepedological studies (2) : Anabiosis in *Chthamalus*.—A. Stefanelli : The existence of diffuse nervous networks with expansional significance in reptiles.—M. Comel : The reciprocal equilibrating power of two regulating phosphate solutions. The results of experiments on Jarisch solutions with different hydrogen ion concentrations, and on their behaviour towards muscle, confirm the possession by tissues of marked ability to regulate chemical reaction. By the action of equilibrating systems formed of slightly dissociated complex acid-salts, the tissues seem capable of maintaining their reaction close to the neutral point, at any rate in the presence of acid solutions.—G. Lentati : Experiments on the histogenesis of the islets of Langerhans.

Diary of Societies.

FRIDAY, NOVEMBER 9.

FARADAY SOCIETY (at Royal Institution), at 3.30.—Sir Oliver Lodge : Some Debatable Problems in Physics (Spiers Memorial Lecture).

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—J. W. Madeley : Town Water Supply in India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. W. M. Smart : On the Frequency Distribution of Restricted Proper Motions.—M. A. Ellison : Micrometrical Measures of the Potsdam Double Stars, made with the 10-in. Refractor of the Armagh Observatory.—K. Nakamura : Observation of Meteors from Skjellerup's Comet, 1927 *k*.—Prof. S. Chapman : The Electrical Conductivity of Stellar Matter.—Dr. W. J. S. Lockyer : A Wide Absorption Band in some *B*-type Stars.—W. M. H. Greaves and H. W. Newton : Magnetic Storms and Solar Activity, 1874–1927.—Prof. E. A. Milne : (*a*) The Theoretical Contours of Absorption Lines in Stellar Atmospheres ; (*b*) Ionisation in Stellar Atmospheres : Generalised Saha Formulæ : Maximum Intensities and the Determination of the Coefficient of Opacity.—Prof. S. Chapman : On the Radial Limitation of the Sun's Magnetic Field.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—J. B. Seth, Chetan Anand, and Gian Chand : The Effect of Moist Air on the Resistance of Pencil Lines.—Dr. L. F. Richardson, V. Stanyon, and other Students of Westminster Training College : An Absolute Current-balance having a Simple Approximate Theory.—Prof. E. V. Appleton : Notes on Wireless Methods of Investigating the Electrical Structure of the Upper Atmosphere. I.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.—H. Lemche : On some Uncertain Species of *Anticranchiata* from the North Atlantic Ocean.—Lt.-Col. A. J. Peile : (*a*) Radula of *Monomphalus* ; (*b*) A new *Indoenaea* from the Malay States.—L. R. Cox : The Varietal Names in K. Schreiber's Vers. Conch. Linnés Syst. 1793.—J. R. le B. Tomlin : Description of Two New Species of *Tortulosa*.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. M. C. Lance and others : Discussion on Loud Speakers.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—E. T. Elbourne : Marketing Engineering Products Overseas.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Temperance Institute, Keighley), at 7.30.—C. H. Carter : Precise Length and Angular Measurement.

INSTITUTE OF METALS (Sheffield Local Section) (in Applied Science Department, Sheffield University), at 7.30.—Prof. F. C. Thompson : Flow in Metal Shaping Processes.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—B. Campbell : Nitrocellulose Finishes.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—A. H. Levy : Injury of Lens causing Alteration of Refraction.—A. F. MacCallan : Ocular Manifestations of Local Sepsis.

SATURDAY, NOVEMBER 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. T. E. R. Phillips : Recent Observations and Discoveries respecting the Planets (II.).

PHYSIOLOGICAL SOCIETY (in Department of Physiology, London Hospital Medical College), at 4.—D. Hunter : Some Observations on the Regulation of Calcium Metabolism.—J. H. Shaxby : The Resonance Theory of Audition : a Historical Note.—J. R. Marrack : Note on the Osmotic Pressure of Mixtures of Pseudo- and Euglobulin.—Prof. H. E. Roaf : Discrimination of Colour.—Demonstrations :—W. A. M. Smart : Some Labour-saving Devices for the Research Worker :—(*a*) Slide Rule : Surface Area of Body ($S = 71{\cdot}84\ W^{0{\cdot}425}\ H^{0{\cdot}725}$) ; (*b*) Nomograms—Correlation by Ranks :—

$$(r+1)/2 = \text{Cos } 2\pi\ \Sigma d/(N^2-1),$$
$$r = \text{Sin}\ \ \pi\ [1 - 6\ \Sigma d/(N^2-1)]/2,$$
$$r/2 = \text{Sin}\ \ \pi\ [1 - 6\ \Sigma d^2/N\ (N^2-1)]/6\ ;$$

(*c*) Probability Paper—an Improved Type.—F. Campbell Smith and C. Gordon-Wilson : The Cadmium Photo-electric Cell as a Means for Measuring the Absorption of Ultra-violet Radiation in Dilute Physiological Fluids.—J. T. Cunningham : Effect of Raised Temperature on Seminal Epithelium.—Prof. H. E. Roaf : (*a*) An Apparatus for Quantitative Measurement of Differences in Colour Discrimination ; (*b*) Identity of the Yellow Sensation produced by Mono- and Hetero-chromatic Light ; (*c*) A New Perimetric Device.—H. T. Goodwin : A New Design for Students' Drums.

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—Prof. G. E. Scholes : Heat Engine Cycles.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (at Glasgow).—Dr. A. McCance and J. Jefferson : Steel Castings.

MONDAY, NOVEMBER 12.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Capt. J. G. Withycombe : Lettering on Maps.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.—Major W. D. Keyworth : Severe Malaria among British Troops in the East African Campaign.

SOCIÉTÉ DES INGÉNIEURS CIVILS DE FRANCE (at Institution of Mechanical Engineers), at 5.30.—M. Fieux : Twin Gyro Stabiliser.

INSTITUTION OF AUTOMOBILE ENGINEERS (Midlands Centre) (at Queen's Hotel, Birmingham), at 7.—L. H. Hounsfield : The Integrity of the Technical Man.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. Coxon and others : Discussion on Engineering Requirements of a Modern Office Building.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (jointly with North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Prof. S. P. Smith : Automobile Ignition Systems.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—Dr. J. D. Morgan : Action of a Spark-gap.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 7.—H. W. Gambrell : A Complete Electric Radio-Gramophone Equipment.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Branch) (at Borough Polytechnic), at 7.30.—H. F. W. Joyce : Space occupied by Heating and Ventilating Apparatus.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. C. Sturney : Nickel in the Non-Ferrous Foundry.

ROYAL SOCIETY OF ARTS, at 8.—Dr. F. Kidd : Biology and Refrigeration (Cantor Lectures) (I.).

SURVEYORS' INSTITUTION, at 8.—C. B. Fisher : Presidential Address.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in University Chemical Laboratory, Cambridge), at 8.45.—Dr. E. K. Rideal : Chemiluminescence.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at South Wales Institute of Engineers, Cardiff).—H. B. Poynder : Some Practical Considerations in the Design of Automatic Equipments for Heavy Traction Sub-stations.

TUESDAY, NOVEMBER 13.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Tropical Diseases Sections), at 5.—Dr. J. B. Christopherson, Prof. A. J. Gunn, Sir Leonard Rogers, and others : Joint Discussion on The Special Uses of Antimony.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. H. L. Callendar : Co-aggregation *versus* Continuity in the Change of State from Liquid to Vapour (Tyndall Lectures) (III.).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—G. Heseldin : Drilling and Production Methods in the Greater Seminole Field, Oklahoma, U.S.A.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Major R. H. Mayo : Air Transport.

INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (at Loughborough College), at 6.45.—S. H. Holden : Electricity Meters.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 7.—J. H. Lane : Recent Developments in Beet Sugar Manufacture.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—W. B. Woodhouse : Overhead Electric Lines (illustrated by Cinematograph Film).

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—F. Lydall : The Electrification of the Pietermaritzburg-Glencoe Section of the South African Railways.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—Examples of Modern British Film Production.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—Dr. E. C. Wadlow : The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—D. S. Munro : Some Tendencies in Installation Work (Chairman's Address).—P. D. Morgan : Electrical Research Association Report on A Critical Study of the Current Rating of Low-Pressure Ordinary-Duty Fusible Cut-outs.

QUEKETT MICROSCOPICAL CLUB, at 7.30.

HULL CHEMICAL AND ENGINEERING SOCIETY (Grey Street, Hull), at 7.45.—H. Thompson : The Chemistry of Food.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—C. J. S. Thompson : The Apothecary and some Curious Materia Medica of the Seventeenth Century.

INSTITUTION OF MECHANICAL ENGINEERS (South Wales Branch) (at Swansea).—W. O. Dayson : Chairman's Address.

WEDNESDAY, NOVEMBER 14.

ROYAL SOCIETY OF MEDICINE (Surgery : Sub-Section of Proctology), at 5.30.—Dr. C. Dukes and others : Discussion on Urinary Infections after Excision of the Rectum ; their Cause and Prevention.

INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. P. Klein : Making Rubber Goods of Latex by Electro-Deposition (Lecture).

BELFAST ASSOCIATION OF ENGINEERS (at Municipal College of Technology, Belfast), at 7.30.—A. W. Brown : Low-pressure Hot Water Heating.

INSTITUTION OF MECHANICAL ENGINEERS (Sheffield Branch), at 7.30.—H. E. Yerbury : Corrosion of Metals and its Prevention.

ROYAL SOCIETY OF ARTS, at 8.—O. Ramsden : English Silver and its Future.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff).—Dr. F. Arnall : The Training of a Works Chemist.

THURSDAY, NOVEMBER 15.

ROYAL SOCIETY, at 4.30.—Prof. S. W. J. Smith, A. A. Dee, and J. Young : The Mode of Formation of Neumann Bands. Part I. The Mechanism of Twining in the Body-Centred Cubic Lattice. Part II. The Evidence that the Bands are Twins. Part III. The Movement from which the

Twining Results.—Dr. C. F. Elam: An Investigation of some Banded Structures in Metal, with an Appendix by Prof. G. I. Taylor.—F. H. Rolt and H. Barrell: The Difference between the Mechanical and Optical Lengths of a Steel End-Gauge.—D. A. Jackson: Hyperfine Structure in the Arc Spectrum of Cæsium and Nuclear Rotation.—*Papers to be read in title only*:—G. S. Adair: A Theory of Partial Osmotic Pressures and Membrane Equilibria with special reference to the Application of Dalton's Law to Hæmoglobin Solutions in the Presence of Salts.—A. T. Waterman: The Effect of Electric Fields on the Emission of Electrons from Conductors.—A. T. Price: A Mathematical Discussion on the Structure of Wood in Relation to its Elastic Properties.—Prof. A. Fowler and E. W. H. Selwyn: Further Investigations of the Spectrum of Singly Ionised Carbon (C II).—Prof. O. W. Richardson and F. C. Chalklin: The Soft X-Ray Levels of Iron, Cobalt, Nickel, and Copper.—W. Mandell: (*a*) The Change in Elastic Properties on Replacing the Potassium Atom of Rochelle Salt by the Ammonium Group; (*b*) The Determination of the Piezo-Electric Moduli of Ammonium Seignette Salt.—Prof. A. M. Tyndall, L. H. Starr, and C. F. Powell: The Mobility of Ions in Air. Part IV. Investigations by two New Methods.—Prof. A. M. Tyndall, G. C. Grindley, and P. A. Sheppard: The Mobility of Ions in Air. Part V. The Transformation of the Positive Ions of Short Ages.—L. J. Freeman: The Spectrum of Doubly Ionised Nitrogen (N III).—W. R. Dean: Fluid Motion in a Curved Channel.—H. E. Watson and A. S. Menon: The Electrical Conductivity of Thin Oil Films. Part I.—W. Kapuscinski and J. G. Eymers: Intensity Measurements in the Secondary Spectrum of Hydrogen.—E. Rudberg: Some Remarks concerning the Production and Absorption of Soft X-Rays and Secondary Electrons.—E. J. Williams, J. M. Nuttall, and H. S. Barlow: The Special Distribution of Photo-Electrons produced by X-Rays.—L. W. Nordheim: The Effect of the Image Force on the Emission and Reflection of Electrons by Metals.—B. Swirles: The Internal Conversion of Gamma Rays. Part II.—W. G. Kannuliuk and Prof. T. H. Laby: The Thermal and Electrical Conductivity of Copper Crystals at various Temperatures.—Dr. H. Jeffreys: On Aerofoils of Small Thickness.—R. S. Bartlett: The Increase in Thermionic Currents from Tungsten in Strong Electric Fields.—H. D. H. Drane: Elastic Constants of Fused Quartz. Change of Young's Modulus with Temperature.—L. H. Thomas: On the Rate at which Particles take up Random Velocities from Encounters according to the Inverse Square Law.—F. A. Jenkins and H. de Laszlo: Structure of the Violet Bands of Silicon Nitride.—R. A. Fisher: The General Sampling Distribution of the Multiple Correlation Coefficient.—Prof. G. I. Taylor and C. F. Sharman: A Mechanical Method for Solving Problems of Flow in Compressible Fluids.—Prof. A. S. Eddington: A Symmetrical Treatment of the Wave Equation.—A. C. Menzies: Ground Terms on the Spectrum of Nickel II. and Proposed Standard Wave-length in the Schumann Region.—J. M. Whittaker: On the Principle of Least Action in Wave-Mechanics.—Dr. J. A. V. Butler: The Equilibrium of Heterogeneous Systems including Electrolytes. Part III.—Prof. T. H. Havelock: The Wave Pattern of a Doublet in a Stream.—G. R. Goldsbrough: The Tides in Oceans on a Rotating Globe. Part II.—T. Bradshaw and Prof. G. H. Livens: The Formula for the Optical Rotatory Dispersion of Quartz.—Dr. H. T. Flint: The New Metric of Einstein and the Wave Equation.

LINNEAN SOCIETY, at 5.—Dr. H. H. Thomas: Further Observations on the Cuticle Structure of Mesozoic Cycadean Fronds.—A. H. Clark: On some Recent Crinoids in the Collection of the British Museum.—Dr. C. A. Nilsson-Cantell: New and Interesting Species of *Scalpellum* from a Telegraph Cable near the Coast of North Chile.—Prof. W. M. Tattersall: *Asellus cavaticus* Schiodte, a Blind Isopod new to the British Fauna, from a Well in Hampshire.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Capt. G. Pitt-Rivers: The Clash of Culture (III.). The Empire and the Native Problem.

BIOCHEMICAL SOCIETY—UNIVERSITY OF BIRMINGHAM (at University of Birmingham), at 5.30.—P. J. Powell: Beet Sugar Manufacture—Providing the Raw Material.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—J. D. Young: *Losses of Efficiency in Steamship Operation.*

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—Open Discussion on Standardisation.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Demonstration of Colour Photography.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—Dr. W. J. Jenkins: Nitro-Cellulose Lacquers and Enamels.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.

CHEMICAL SOCIETY, at 8.—F. L. Gilbert and Prof. T. M. Lowry: Studies of Valency. Part XII. Isomeric Derivatives of Diethyl Telluride.—Prof. T. M. Lowry and F. L. Gilbert: Studies of Valency. Part XIII. Further Experiments on the Molecular Structure and Configuration of the Quadrivalent Derivatives of Tellurium.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting) (at London School of Hygiene and Tropical Medicine), at 8.15.—Demonstrations by Major H. C. Brown, Dr. W. T. C. Broom, Dr. P. A. Buxton, Dr. L. J. Davis, B. Jobling, Dr. S. Sharpe, Miss E. K. Sikes, Dr. A. C. Stevenson, Dr. C. M. Wenyon, Dr. E. Hindle, V. B. Wigglesworth, Prof. Warrington Yorke.—Dr. L. E. Napier: Cinematograph Film, Scenes in the Kala-Azar Endemic Areas in Bengal.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch).—H. E. Yerbury: Corrosion of Metals and its Prevention.

INSTITUTION OF MINING AND METALLURGY (at Geological Society).

FRIDAY, NOVEMBER 16.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Prof. S. Chapman, W. M. H. Greaves, and others: Magnetic Phenomena in Relation to the Upper Atmosphere and to Solar Activity.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital Medical School), at 5.—V. B. Reader: A Third Factor Present in Marmite, necessary for the Nutrition of the Rat.—H. J. Holman and Prof. S. B. Schryver: The Separation of the Basic Products of the Hydrolysis of Proteins.—J. R. Marrack: Ketosis in Sea-sickness.—Dr. L. J. Harris and T. Moore: Hypervitaminosis.—M. G. Eggleton and P. Eggleton: A Method of Estimating Phosphagen and other Phosphorus Compounds in Voluntary Muscle.—W. J. N. Burch: A Synthesis of Hydroxyglutamic Acid.—W. J. N. Burch and Prof. R. H. A. Plimmer: Esters of Phosphoric Acid.—J. Lowndes and Prof. R. H. A. Plimmer: Bromination of Histidine.—Prof. R. H. A. Plimmer, W. H. Raymond, and J. Lowndes: Comparative Vitamin-B Values of Foodstuffs.—H. Allen, F. Dickens, E. C. Dodds, and F. C. Howitt: A Study of the Œstrus-producing Hormone with Special Reference to its Preparation and Standardisation in Water-soluble Form.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. H. W. Swift: Power Transmission by Belts: an Investigation of Fundamentals.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—E. Windle: The Locomotive Smoke-box.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.—T. H. B. Scott: British Cottage Homes.

GLASGOW DYERS' SOCIETY (at 7 Gordon Street, Glasgow), at 7.15.—Dr. S. G. Barker: Some Scientific Aspects of Wool as they affect the Wearer.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. H. Croucher: Some Applications of Time and Remote Control Switches.

TEXTILE INSTITUTE (Lancashire Section) (jointly with Blackburn Textile Society) (at Technical College, Blackburn), at 7.30.—A. Munro: Art, Textile Decoration, and Commerce.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. R. H. Pickard: The Aims of Recent Research at the Shirley Institute.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at Grosvenor Restaurant, Gordon Street, Glasgow).—The "James Watt" Lecture.

SATURDAY, NOVEMBER 17.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. G. Whittaker: North Country Folk Music (I.).

BRITISH ASSOCIATION OF CHEMISTS (Annual General Meeting) (at Birmingham), at 7.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—P. A. Russell: Shrinkage Holes in Small Grey Iron Castings.

BRITISH MYCOLOGICAL SOCIETY (at University College).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 9.

UNIVERSITY COLLEGE, at 5.30.—W. L. Cook: The British Coal Industry.

SATURDAY, NOVEMBER 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Swiss Scenes and Flowers.

MONDAY, NOVEMBER 12.

UNIVERSITY COLLEGE, at 5.30.—Dr. P. Stamberger: The Colloid Chemistry of the Rubber Industry. (Succeeding Lectures on Nov. 14, 16, 19, and 21.) (Gow Lectures.)

INSTITUTION OF CIVIL ENGINEERS, at 8.—H. E. Stilgoe: Some Aspects of the London Water Supply (Chadwick Public Lectures).

TUESDAY, NOVEMBER 13.

KING'S COLLEGE, at 5.30.—Miss Evelyn Underhill (Mrs. Stuart Moore): The Philosophy of Contemplation.

UNIVERSITY COLLEGE, at 6.30.—P. Dunsheath: High Tension Transmission of Power. (Succeeding Lectures on Nov. 20, 27, Dec. 4 and 11.)

WEDNESDAY, NOVEMBER 14.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. R. H. B. Adamson: The Health of Women and Girls in Relation to Industry.

KING'S COLLEGE, at 5.30.—Prof. R. J. S. McDowall: The Indebtedness of Industry to Pure Science: Physiology and National Efficiency.

FRIDAY, NOVEMBER 16.

KING'S COLLEGE, at 8.—Prof. A. R. Ling: Contributions to the History of Starch and its Transformation Products (Streatfeild Memorial Lecture).

SATURDAY, NOVEMBER 17.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: "Missing Links" and Evolution.

CONGRESSES.

NOVEMBER 14, 15, 16, AND 17.

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY.

Exhibition and Meetings.

Wednesday, Nov. 14.

At 8.15 (in Barnes Hall, Royal Society of Medicine).—Prof. W. L. Bragg: X-Ray Optics (Mackenzie-Davidson Memorial Lecture).

Thursday, Nov. 15 (at Central Hall, Westminster).

At 10.30 A.M.—Exhibition of X-Ray Apparatus.

At 2.30.—Dr. G. W. C. Kaye: Radiology, Mediæval and Modern (Presidential Address).

At 5.—Dr. W. S. Handley: Radiology from a Surgeon's Standpoint (Silvanus Thompson Memorial Lecture).

Friday, Nov. 16 (at Central Hall, Westminster).

At 10 A.M.—Exhibition.

At 10–11.30 A.M.—Sir Thomas Horder, Bart., A. J. Walton, Dr. A. E. Barclay, and others.—Discussion on The Value of the Opaque Meal in Diagnosis.

At 10.15 A.M.—W. V. Mayneord: The Distribution of X-Rays within an Irradiated Medium.

At 10.45 A.M.—Dr. G. Shearer: Some Applications of X-Ray Spectroscopy to Industrial Problems.

At 2.30–4.—Continuation of Discussion on Opaque Meals.

At 2.30.—W. E. Schall: Some Engineering Lessons from Stockholm.

Saturday, Nov. 17.

Visit to National Physical Laboratory.

NOVEMBER 19–24.

INTERNATIONAL CONFERENCE ON BITUMINOUS COAL (at Pittsburgh, Pa., U.S.A.).—Among the subjects to be discussed are:—Fixed Nitrogen, The Liquefaction of Coal, Low Temperature Distillation, High Temperature Distillation, Power from Coal, Coal Tars, and Oils, Complete Gasification of Coal, Origin of Coal, Coal Washing, Pulverised Coal, Catalysts, and the general aspects of the Bituminous Coal Industry.

SATURDAY, NOVEMBER 17, 1928.

CONTENTS.

Reform of the British Patent System.[1]

THE recent publication of the Report of the Committee which was appointed by the British Science Guild in April of last year to consider what changes could advantageously be made in the patent law of Great Britain, will of necessity rivet the attention of all those who appreciate the very important part which a sound system of monopoly grants in respect of new inventions can achieve in encouraging progress in industrial development. The days are long past when the desirability of granting patents for inventions was regarded as a debatable matter, and the abolition of patents was advocated by quite responsible schools of opinion as being one step in the direction of freeing trade and industry from all those trammels and obstacles that hinder full development. More and more we have come to recognise that the well-being of a modern industrialised State depends on the continuous and intensive concentration of the most original and creative minds upon the task of increasing the efficiency of human labour, that is to say, in enabling more wealth to be produced or more services to be rendered by a given expenditure of human effort.

Progress in the application to useful ends of the rapidly growing knowledge furnished by science, and progress in that widely different sphere of inventive art which leads to the construction of automatic or semi-automatic labour-saving machinery—these are vitally essential if the growing populations of great industrial States are to enjoy even a reasonable minimum of welfare and contentment. Inventions such as the telephone or the manufacture of artificial silk on one hand, and inventions such as linotype and monotype machines, or boot and shoe making machinery on the other, typify the manner in which a relatively small proportion of originative or creative minds can add, generation by generation, to the effective capital of human knowledge, and thus provide the equivalent as regards all the needs of life except perhaps the primary need of foodstuffs, of the proverbial means whereby two blades of grass are made to grow where one only grew before ; and even the fundamental industries of agriculture, stock-raising, and dairy farming owe much to purely scientific experiment and research and to the inventors of the more complicated forms of mechanical aids to labour.

With a growing perception of the necessity for

[1] "Report of the Committee a[illegible]ted by the British Science Guild to consider the Reform of the Bri[illegible] Patent System." Pp. 48. (London : British Science Guild, 1928.) 2s.

encouraging and utilising to the full such inventive capacity as is available in any given generation, we have come to realise that under modern conditions it is more than ever difficult to give the inventor his full opportunity, unless really effective protection by way of monopoly is accorded to new inventions for a term of years. Such protection is necessary for two reasons. First, there is in every industry severe competition, and every manufacturer must be watchful of improvements or he will not keep abreast of the times; knowledge of new methods diffuses rapidly through the technical press: and modern methods of transport have overcome the barrier offered by distance. There is no question, therefore, of even a temporary monopoly accruing to the originator of some new machinery or some new process in the absence of any legal monopoly rights. Secondly, capital plays a larger and larger part in the development of industry. Even minor though useful inventions frequently demand a capital expenditure far beyond the range of an individual inventor before they can be put effectively upon the market; and if capital is to be attracted to a new and unproven enterprise, some security must be afforded that when the experimental period is over, and the new article is upon the market, or the new process is in operation on a commercial scale, watchful competitors will not at once step in and reap, or at least share the reaping, where they have not sown.

There is perhaps a tendency in these days to give disproportionate public recognition to the inventions that originate in scientific work as opposed to those that owe little to the growth of scientific research. The public is continually being asked to admire some new miracle of science. Such inventions as photography, the telephone, the transmission of power by electricity, radio telegraphy and telephony, synthetic chemistry, X-rays, kinematography, television, and so forth, strike the public imagination as being marvellous achievements arising directly out of scientific researches of which they can understand but little. Improvements in textile machinery, boot and shoe making machinery, wood-working machinery, refrigerating plant, bread-making machinery, and automatic machine tools are less calculated to strike the public imagination, but they play at least as large a part in solving the problem of maintaining or improving the standards of life of large and still growing populations. Inventions of this latter kind are not without their debts to science, but they largely arise by the creative energy of minds not mainly trained and developed in the laboratory. There is an originative type of mechanical mind that owes little to scientific knowledge.

Both of these types of creative invention, however, depend largely on a sound system of patent law if they are to be encouraged and developed and are to have their full effect on the general public welfare. Patent law and patent jurisprudence are therefore subjects deserving of serious study by any government, and should be revised and modified from time to time so as to preserve their full efficiency as instruments of progress.

The law in relation to patents should be so framed and so administered that, on one hand, it furnishes to the inventor and to his coadjutor the capitalist a secure protection for such new manufacture or improvement in old manufacture as has in fact been made. On the other hand, the law should be such, and its administration should be such, that if the inventor makes unduly broad claims, such as would either encroach upon existing rights or liberties, or would extend too far beyond the ground actually explored and brought under cultivation, as it were, by the inventor, such unduly broad claims can be refused, or at least made the subject of an official warning to the public.

There is always a danger that patents, if granted too freely without careful consideration of the existing state of the art, may hamper those who ask no more than to use existing knowledge intelligently in the ordinary variations of manufacture. There is also the danger that an astute draftsman of the claims in a patent specification may endeavour to claim in advance, developments not unlikely to flow from the invention, but as yet unexplored and unknown. He may stake out, as it were, a whole county instead of pegging out the claim upon which the inventor, as prospector, has established some sort of equitable title. Very real evils, particularly in the chemical industry, arise out of this last-named tendency, which has been fostered by a change in the law made in 1919 whereby a patentee can succeed in his first action for infringement despite the presence in his specification of one or more unwarrantably broad claims.

Broadly speaking, it may be said that the patent law of Great Britain is soundly framed, and that its administration both by the Comptroller-General and in the Courts is carried out efficiently and with balanced and equitable judgment in reconciling the interests of the inventor and of the public. But in very many directions, both of detail and of major import, there is undoubtedly room for reform, both legislative and administrative. In recent years,

demands for such reform have been increasingly manifest.

Paradoxical as it may seem, the greatest single reform that could be carried out would probably be the provision of some means whereby patent litigation could be encouraged by rendering it inexpensive. It is not far from the truth to say that the validity of no patent is certain until it has actually been tested in the Courts. It is also true to say that industry would be greatly benefited if there were some more expeditious and inexpensive way of determining if a particular mode of manufacture is or is not an infringement of a patent which is alleged to include such manufacture within its claims.

There is at present far too much uncertainty in relation both to the validity and to the scope of patents. Each patent is in the nature of a prohibition or warning to avoid certain modes of manufacture, and the number of patents actually in force at any one time in each industry varies from hundreds up to many thousands. One can easily picture the confusion that would exist in relation to real property if the boundaries of thousands of important estates were indefinite and the titles themselves uncertain, and it were known that neither could be determined except by a very expensive process of law. This is practically the position in relation to patents. The technical issues are frequently complicated and difficult, and the costs of a judicial settlement are great. The determination of the issue of validity or infringement, or more frequently of both, is a luxury that few can afford. If the patentee has the smaller purse, he may be helpless against the infringer; if the patent is in very strong financial hands, it may be made the basis of excessive or even wholly unwarranted demands. But although no other reforms can be fully effective while this difficulty remains unresolved, it presents a problem to which no solution can readily be found. The Report of the British Science Guild touches upon it only partially and tentatively.

Reform of the patent law being admittedly called for, the British Science Guild deserves thanks for its initiative in appointing a strong and representative committee to consider this matter and to report thereon. The Committee, under the distinguished chairmanship of Dr. W. H. Eccles, has presented a Report which it may be safely said will furnish invaluable aid to those whose duty it may be to draft any future Patents Bill for consideration by Parliament. The Report covers a great deal of ground, and it is impossible to furnish here anything in the nature of a compendium of its contents.

Many of the recommendations made in the Report are uncontroversial and arise out of the experience of the nine years since the passing of the Patents Act of 1919. It may indeed be assumed that but for the serious and growing difficulty arising out of the shortage of available Parliamentary time, many of the anomalies, deficiencies, and defects which have been disclosed by experience would already have been remedied by the passing of an amending Act when opportunity presented itself. Until Parliament is prepared to delegate more of its work to standing or select committees, it is difficult to see how, under present-day conditions, the Statute Book is to receive necessary emendation in all the many ways in which such changes are called for. Perhaps patent law is in no worse case than many other branches of the law in that respect.

Apart, however, from these minor recommendations, which, taken collectively, are of no inconsiderable value, the Committee has dealt with a number of more important issues, and it may be useful to direct special attention to certain recommendations which deserve full consideration and discussion.

The Committee recommends that the search made in the Patent Office as regards novelty should no longer be restricted to British specifications, but should be extended to other relevant documents. At the present time the statutory search is limited to the last fifty years of British specifications. The examiner sometimes cites informally some publications outside this restricted field that are within his knowledge, but it is for the inventor to say whether he will act upon such communicated information or not. There is a certain anomaly in the fact that although the official search is so restricted, an opponent to the grant of the patent may bring forward any documentary publication whatever that has been made in Great Britain, including of course the published specifications of other countries.

In opposition proceedings the Comptroller may thus amend the claims or even refuse the grant of a patent, on the basis of documents which the examiner could not formally cite even if they were within his knowledge. The Committee recognises that an extension of the search to cover the scientific and technical literature of the world and the patent specifications of foreign countries involves an immense task, that could perhaps never be fulfilled in its entirety; but it advises that such an extension of the field of search should be introduced gradually, and it also points out that the large balance of receipts from patent fees over expenditure, which is at present used for the general purposes of the national exchequer, would cover the

cost of a very large extension of the official area of search. The advantage of such an extension would be that it would increase the security and so improve the status of British patents, and thus be conducive to the financial support which is so necessary to an invention in its early stages.

The Committee makes a recommendation which will be of interest to research workers in fields of science which are systematically explored by known methods of research. It states that there is a fear in the minds of some research workers that the validity of patents for research inventions may be imperilled by the circumstances of their origin. The Committee sees no necessity in this case for statutory enactment, but expresses the opinion that the Courts, in deciding upon the presence of subject matter for a patent in any particular instance, ought to give very favourable consideration to an alleged invention which has arisen from prolonged and meritorious research work even on a laboratory scale.

On the vexed question of granting monopoly rights in respect of discoveries which at the time they are made are not seen to be clearly capable of industrial use, the Committee makes no recommendation. The matter is one that has recently engaged the attention of the League of Nations, but it is admittedly a most difficult problem to deal with in any practical fashion.

On the question of biological inventions, the Committee thinks that something could be done to permit the patenting of a wider range of such inventions than is now possible, excluding, however, inventions subserving medical treatment. As regards these last-named inventions, the Committee is impressed by the strong adverse view of the medical profession. On the broader question, the difficulties are set forth with great clarity in a letter from Sir Daniel Hall which is printed as one of the appendices to the Report. Sir Daniel Hall, while wishing the British Science Guild success in its exploration of this question, confesses that he has never seen a method on which it might reasonably be hoped to secure legislative action.

The Committee is of opinion that the Comptroller should be entitled to call, where in doubt, for *prima facie* evidence that the invention has been described in a practicable form in the specification, and to endorse the specification with a warning notice where his objection is not satisfied. It recognises that in many cases such a course would scarcely be fair to the inventor, but the procedure could be used with devastating effect when dealing with the inventors of perpetual motors and of like impracticable schemes, and in cases where a dishonest specification is filed in which knowledge essential to successful working is withheld.

The Report does not, however, endorse a suggestion that four years after applying for his patent a patentee should be given an opportunity of revising his description, and that after an official inspection of his process the Comptroller should, if satisfied, give a certificate of sufficiency of description. This proposal was put forward to meet the difficulty that in the commercial working of an invention details are frequently found to be important which are not recognised as such at the time of filing of the original specification, and it is in the public interest as well as in that of the inventor that the specification of a proved and successful invention be made as full and perfect as possible in all its details. The matter is perhaps one that deserves further consideration.

'Short term patents' form the subject of an interesting section of the Report. It is recommended that a type of patent corresponding in part to the German *Gebrauchsmuster* or utility design be introduced into the British system. Such patents would be granted, for a period not exceeding seven years, for new and useful variations of known constructional forms and arrangements, and possibly also for compositions characterised by the inclusion of new ingredients. The scope of such patents should be narrow and rigorously defined, and the scale of fees should be low.

The heavy expense attaching to patent actions in the High Court, to which reference has been made above, has led the Committee to recommend legislation whereby the Comptroller should be empowered to act as a Court, subject to a definite limit of damages and to the consent of the parties, for deciding questions relating to the infringement of patent rights and for deciding at any time upon petitions and counter claims for the revocation of patents on all the usual grounds of invalidity. The parties should in each case agree beforehand as to whether the Comptroller's decision is to be final or subject to appeal. The Committee also recommends that appeals from the Comptroller's decisions should in all cases be heard by a special judge in chambers, instead of by the Law Officers of the Crown, to whom the large majority of appeals are at present referred under statute.

The Report closes with a recommendation that failing the institution of an Empire patent, in connexion with which the difficulties have so far proved insuperable, there should be provision for the grant of a restricted British Empire patent which should run throughout the Crown Colonies

and Protectorates. Should India or any of the self-governing Dominions be willing to become parties to the scheme, their adhesion should be welcomed.

We have said enough in this incomplete summary to show that the Report is a document well deserving of close study by all who are interested in the reform of British patent law. It may be hoped that the British Science Guild and the Committee will reap the reward that would be most welcome to them, namely, the knowledge that their labours have contributed in some degree at least to the advancement of industry and to the equitable reward of those engaged in scientific research.

The Last Ice Age.

The Last Glaciation: with Special Reference to the Ice Retreat in North-eastern North America. By Ernst Antevs. (American Geographical Society Research Series, No. 17.) (Shaler Memorial Series.) Pp. x + 292 + 9 plates. (New York: American Geographical Society, 1928.) 3.50 dollars.

THE past decade has seen a great revival of interest in the whole subject of climatic changes. There have been many books presenting as many theories, so diverse as to be mutually destructive. At the same time, a great amount of new knowledge has been gained both by exploration in distant corners of the earth and by the application of exact methods of investigation to the classic centres in Europe and North America. It was evidently time to pause for an impartial consideration of the fundamental facts of the problem, and, so far as the Quaternary glaciation is concerned, we can have no better guidance than that of Dr. Ernst Antevs, with his close knowledge of the work of De Geer in Sweden and his subsequent experience in the other great centre of glaciation in North America. These fundamental problems, which must be definitely solved before we can profitably indulge in more elaborate speculations, are twofold. First, was the Quaternary Ice Age synchronous in different parts of the world? Secondly, what were the peculiar climatic conditions which caused the great accumulation of snow and ice? Both of them are closely involved with the interpretation of the peculiar banded fluvio-glacial clays known as varves.

The question of synchronism has long been obscured by the controversy as to whether the Quaternary Ice Age was a single episode or was divided into a number of alternating glacial and interglacial periods. That controversy now appears to have been decided, for few would disagree with Antevs' verdict that advancing knowledge has brought "a growing conviction that everywhere the glaciation was multiple, consisting of three or four successive epochs." In North America it has long been held that these successive epochs were not equally developed in all parts of the continent, but that the centre of glaciation migrated from west to east. Antevs believes, however, that this migration was a minor feature, and that the various stages were essentially synchronous in different parts of the continent. The same dictum applies to Europe; the correlation of deposits in Europe and North America is more difficult, but all the available evidence points to synchronism. The general similarity and parallelism in Asia also "convincingly show that the glacial and interglacial epochs were essentially synchronous in all the northern hemisphere." In the southern hemisphere the glaciations of South America and Australia appear to correspond in the same way, but it is not yet possible to say that the glaciations coincided in the two hemispheres. Recent comparative studies of annual layers of banded clays appear to show that they did coincide, but Antevs is fully alive to the dangers of long distance correlation on such evidence alone. Thus while a migrating pole is definitely ruled out, astronomical causes still remain possible.

The lowering of sea-level caused by the locking up of water in the form of ice is important in this connexion, but does not lead to a perfectly definite answer. Antevs' calculation of the ice volume at maximum glaciation shows that the accumulation in the northern hemisphere was sufficient to lower sea-level by about 272 feet. The ice in the southern hemisphere in excess of that now present adds about 33 feet. Hence, if the maximum glaciation had been exactly synchronous in all areas, the lowering of sea-level should have been about 305 feet. Actually it was at least 250 feet—additional evidence for synchronism in the northern hemisphere, but not necessarily between north and south.

The discussion of the chronological results obtained from the study of varve clays is cautious, but the correlation of the slow retreat of the ice-border across southern Ontario with the prolonged oscillations in the Danish islands and southern Scania is regarded as almost certain. This phase ended about 14,000 B.C.; from a consideration of all the evidence, Antevs decides that the last ice sheets had their greatest extent and began to wane between 5[illegible],000 and 30,000 years ago.

The comparative study of various centres of

glaciation points strongly to low summer temperature as the dominant factor in glaciation, though increased snowfall was locally important, especially in the tropics. This verdict of Antevs' suggests a general increase of cloudiness as the immediate cause of the ice age; it is for meteorologists to say what caused the increase of cloudiness.

The book closes with a detailed account of the author's studies of varve clays in North America. This part is for the specialist only, while the first half of the book is of very general interest. The first half is not nearly long enough, and one could have wished that the author had devoted the whole of this book to a fuller discussion of the general problems, and treated the special varve studies in a separate volume. C. E. P. BROOKS.

Scientific Humanism.

The Scientific Habit of Thought: an Informal Discussion of the Source and Character of Dependable Knowledge. By Prof. Frederick Barry. Pp. xiii + 358. (New York: Columbia University Press; London: Oxford University Press, 1927.) 17*s*. 6*d*. net.

PROF. BARRY, of the Columbia University, has written an important and timely book on a question, or series of questions, which must often occupy the minds of readers of this review. How is it that the colossal progress of science, and the way in which science now permeates and dominates every department of practical life, is so little appreciated by the mass, even of the thinking public, which is thus dominated? Anyone can see—and this perception prompted Prof. Barry's essay—that there is a great gulf fixed between the practicians of science and that small minority who more or less understand its methods, and the great public who enjoy its inventions and bow the head in distant reverence at its power, but have no conception either of the nature of a scientific discovery or how such discoveries are utilised for the improvement of life. Here, then, is a magnificent subject and a very urgent one—to build a few bridges over this gulf.

Prof. Barry's work is well and usefully done in a book of four chapters, and everyone, expert or layman, would be the wiser for following the author's footsteps. But a word of warning, though not of discouragement, is called for. It is not an easy book. A conscientious reviewer, who makes a practice of reading through his books, sat down to get through it comfortably after dinner. He found it demanded several sittings and a running analysis. It might, indeed, have been improved for its wholly admirable purpose if the author had broken it up more himself, used more illustrative instances, and a simpler and more direct style of writing.

Reading the book straight through once and then returning to pick out the main thread more clearly, one finds it constructed on an excellent logical plan, proceeding from the primitive unanalysed elements of scientific thinking and advancing by broad historic stages to our present state of knowledge and education. We have first a chapter on the nature of science; a very useful discussion, starting from the mass of interwoven fact and hypothesis which together make up our knowledge and opinion about the world and ourselves, and showing how this has become differentiated into the three main branches with their increasing subdivisions. The three main branches are soundly divided and on the whole accurately described. They are (1) logic and mathematics, to be put either first or last according to our point of view at the moment. These are the sciences of method, if we are proceeding from them upwards, or as the sciences of the highest form of life in thought, if we are reaching them through biology. (2) The sciences *par excellence*, astronomy and physics, chemistry, geology, and biology, those bodies of organised knowledge to which mankind has now universally agreed to give the name of 'science.' From these, naturally, the author draws most of the illustrations in the rest of his book. (3) Psychology and the political and social sciences, of which the methods are as various as the facts with which they deal, and of which the organisation ranges from the correlation of sharply defined concepts to loose classification or mere description.

The second chapter is on the nature of fact, and enters on the historic survey which runs underneath the author's whole treatment of the subject, though it might well, in our opinion, have been made more obvious to the reader. The 'fact' is that 'coercive' thing in our experience from which the mind, at least of man, cannot escape. This is analysed with care and excellent judgment by Prof. Barry, who avoids with great skill the pitfalls of subject and object, idealism and materialism. We trace in selected cases, for example, of silver, the emergence of the more and more exact correlation of analysed aspects of the brute fact, until we reach the form of physico-chemical generalisation to which all scientific theory tends.

This leads us to the third chapter on the "Elements of Theory," in which the point of view changes. We are now considering the elaboration

of explanations as a whole rather than the nature of the facts on which they are based. The author rightly fixes on the Pythagorean problem and the Greek atomic theory as the two most important steps in framing the scientific outlook for all mankind. The first was the question of finding means for the complete representation of continuous magnitudes by discontinuous formulations, and, if found, would give us a united science of number, configuration, and movement. The second is the attempt to arrive at the ultimate elements of matter, of our external experience, to which these 'laws' of number, place, and time may be applied.

The last chapter is called 'Scientific Humanism,' and deals with the present general state of education and of the spirit of the scientific worker, *vis-à-vis* the evolution of science as sketched in the earlier chapters. One is not surprised to find that Prof. Barry ends with the advocacy of the history of science as equally necessary for both parties to this debate, if debate it can be called where the opposing sides scarcely ever come into contact. He puts first its importance for the scientific worker himself: he is speaking, of course, of the average student in science. "It is well known that much scientific instruction in our own day is going stale; exactly as literary instruction went stale two generations ago." It is due, he thinks, to the multiplication of laboratory experiments and problem drill without the true spirit of discovery or any realisation of where the work fits into the greater scheme of human civilisation as a whole. The supreme merit of the study of the history of science is that it "humanises a sort of study which is uniquely severe and impersonal . . . it satisfies the spontaneous curiosities which will be aroused by a good lecturer's references to his own or a colleague's investigations. . . . When seriously pursued it yields an insight into the true character of scientific activity and finally provides the most efficacious means for the more intimate blending of scientific and other interests." "But," he adds in another place, "to serve the purposes of scientific humanism the history of science must be made genuinely educative . . . it must become a serious discipline and not a bedtime relaxation."

It is strange that with such good reasons to support it, with which most readers of this review will be in accord, we still have not in England a society to promote the study of the history of science, such as Augustus de Morgan once founded, or as we now see flourishing and doing so much good work in the United States.

F. S. MARVIN.

Papuan Magic.

Orokaiva Magic. By F. E. Williams. Pp. xii + 231 + 7 plates. (London: Oxford University Press, 1928.) 12*s*. 6*d*. net.

IN this volume Mr. Williams has assembled three essays constituting Nos. 6, 7, and 8 of the Anthropological Reports issued by the Government of Papua. As indicated by the title, all three refer to the Orokaiva, the name applied by Europeans to the Binandele-speaking tribes of the lowlands of the Northern Division of Papua, that is, that portion of the great island until recently known as British New Guinea. Of these three essays, the first is by far the most important, the second rather slight, though it contains an interesting account of the rotation of garden areas and the native reasons for the practice. The third, apart from the new material it contains, is interesting as showing how near to a reasonable theory of magic an acute observer and careful reasoner can come, without any overt acknowledgment of recent work on the unconscious, or indeed recognition that it exists. In spite of this it is obvious, at least to the reviewer, that given the same opportunity, this essay could scarcely have been written prior to 1920, by which time ideas as to the importance of the processes of wish-fulfilment and rationalisation as offering reasonable explanations of native thought and customs were beginning to be appreciated. From this point of view such passages as the following are surely most instructive:

"As originally impulsive and truly spontaneous it may be said that the fundamental element in magic consists just in desiring the result, but desiring it in the particular way (viz. without any solid, matter-of-fact basis) which we call *wishing* or *hoping*. One might go so far as to say that whoever hopes against hope, whoever dreams by day and builds castles in the air, has already made magic in his heart. Any emotion or blend of emotions may enter into the hope—hunger, anger, lust, revenge, or whatever other. When we are indulging a wish or a false hope and are enjoying a premature imaginary satisfaction of such emotions, we are in spirit guilty of magic."

And again, "another stage in the indulgence of this false hope or wish comes when we utter it aloud in the spell or the apostrophe. When a man wants rain he cries, 'Rain come!' . . . As he plants the taro he cries, *O ba anumbe jo!*—'Taro, sit tight!' (*i.e.* take root), or *Ba erejo*—'Taro arise!'"

So far so good; it is in his next sentence that Mr. Williams, still trusting to his logical faculty, goes wrong (the italics are the reviewer's):

"It is simply a matter of putting what you wish into words, *though you may have no good reason to expect a fulfilment of the wish.*"

Nevertheless, the whole is uncommonly stimulating. The author points out that such exhortations as those cited above are innumerable, and adds that among the Orokaiva "set magical formulae, if they exist, are uncommon," an observation of some importance in that it supports a suggestion made in a review in NATURE of June 9 (vol. 121, p. 899) of Dr. Landtman's "The Kiwai Papuans of British New Guinea," namely, that the magic of Papuan (in this context meaning no more than non-Melanesian) tribes might be found to differ from those of the Papuo-Melanesians by the absence or slight importance of those carefully framed formulæ or spells which so definitely constitute the most important element in the magic of the Massim. Here at any rate is another Papuan tribe of whom it can be said even more definitely than of the Kiwai that set magical formulæ are unimportant.

The "Taro cult," the subject of the first essay, is perhaps the most important of the several new ecstatic 'religions' which have sprung up in New Guinea since European occupation. It has the usual features of cults arising as the result of the clash of European and primitive cultures, namely, possession (dissociation) with a heightened degree of suggestibility leading to rapid even mass conversion, extending in this instance over a considerable geographical area.

The new cult came into existence through the visions of an individual who believed himself possessed by the spirits of the taro, from whom he received instruction in the rites necessary to ensure an ample crop. These rites, which were simple and included feasting and good fellowship, quickly developed into a popular cult with rather elaborate dancing and ceremonial, the whole originally directed toward the placation of the taro spirits, so that the name 'Taro cult' was not incorrectly applied. But since the taro cult largely replaces the slightly older Baigona cult, which originated as the result of instructions received on Mt. Victory from a snake, Baigona, who in orthodox fashion incarnated or at least represented the spirits of the dead, it is not surprising that the taro worship did not spread very far without a significant change. While the ritual remains substantially the same, the great majority of its devotees regard it as placation, not of the taro spirits, but of the spirits of ancestors or departed relatives who are believed to control the growth of the taro.

The taro cult is then in essence a cult of the dead, though it retains its close association with the taro in that its chief function is to ensure a prosperous taro crop. It is thus at once a fertility cult and a cult of the dead, and in theory at least gives us a glimpse of the possible origin of the many much worn down agricultural ceremonies which exist in other parts of New Guinea, for example, those of the Central District in which the *dubu* plays so large a part, though here (in spite of the enormous amount of vegetable food displayed) there is no question of banana, etc., spirits, and it is only with difficulty that the observer is able to convince himself that the rites are in any way connected with the dead.

Mr. Williams gives a good account not only of the actual symptoms of dissociation, which are those found the world over, but also of the sects or variant cults which have already arisen within the mother ritual, and concludes with some very wise words which should be pondered by every missionary and administrator as to the origin of the movement. He shows that the rapid spread of the cult, in other words its acceptability, is largely due to the suppression of the older interests—he especially instances religion and ceremonial, but he might have included raiding—under the impact of white civilisation, and that it is this suppressed energy which finds expression in the elaborate ceremonial and dissociation states which are characteristic of the cult.

C. G. S.

Alluvial Prospecting.

Alluvial Prospecting: the Technical Investigation of Economic Alluvial Minerals. By Dr. C. Raeburn and Henry B. Milner. Pp. xix + 478 + 32 plates. (New York: D. Van Nostrand Co.; London: T. Murby and Co., 1927.) 36*s.* net.

PRECEDED by an inspiring foreword by Dr. J. D. Falconer, the main body of the text of the work which is at present under review consists of an introduction and ten chapters dealing, amongst other matters, with the classification, lithology, provenance and association of alluvial and allied deposits and minerals; theories of transport and accumulation; prospecting methods; geophysical aids; field work; the report; and laboratory methods. The book in its aim and scope stands alone. It represents a determined effort to raise alluvial prospecting to the status proper to the initial operations of a branch of the world's second most important basic industry, mining.

The authors successfully show that the old-

time scramble must give way to thoroughly scientific search and clearly demonstrate the ways and means that have to be adopted in this quest. They prove beyond doubt that the modern prospector must have had a liberal scientific training in addition to his possessing the attributes of the many worthy adventurers who led the way in the past and did so much for the world; and they seem to wish that the reasoning used by E. H. Hargraves, who discovered gold in Australia, should be stimulated, developed, elaborated, and utilized in accordance with the requirements of the present day. The authors evidently have in view the facts that as much mineral has been drawn out of the earth during the past few decades as during the whole of the previous period of human life; that low-grade propositions are the order of the day; and that the pioneer must be properly prepared.

By the publication of "Alluvial Prospecting," by the presenting to all who wish to learn the result of their foresight, long labour, and determination, by their breaking new ground, the authors have acted indeed as true prospectors; and they are to be congratulated. Happy, too, are they in having a foreword by such an eminent geologist as Dr. J. D. Falconer, who himself has caused many ideas about natural occurrences to be radically modified.

So if the lengths of the ten different chapters are not of the right proportions according to all minds; if, for example, the pages devoted to prospecting methods are only 53; if none of Sir Arthur Quiller-Couch's purple patches are to be found in the text; if some of the terms used seem new and strange; if "index-suites," "fit minerals," and "unfit species" cause imaginations; if all specimens of cassiterite from Amo, Nigeria, are not magnetic; if the chapter on "The Report" does not follow those on laboratory work; if the mining geologist is rather pushed to the front and the mining engineer, the arbiter to whom the directors will look, is not much mentioned, little matters. For there is in the book, and linked with the indication of a praiseworthy purpose, a mass of information contained in no other single volume; and the weaknesses but show that the authors have not practised the plagiaristic eclecticism so apparent and so common in the common scientific work. Yet it would surely be with the approval of the Institution of Mining and Metallurgy that in the preparation of a second edition all advantage should be taken of what emerges from the relevant discussion taking place under the auspices of that body.

F. W. ARMSTRONG.

The Explosives Industry in America.

History of the Explosives Industry in America. By Arthur Pine Van Gelder and Hugo Schlatter. Pp. xxxviii + 1132. (New York: Columbia University Press; London: Oxford University Press, 1927.) 50*s*. net.

IN both Great Britain and the United States the explosives industry has formed one of the most important nuclei round which the powerful chemical combinations now existing in these two countries have developed. A history of the British explosives industry, edited by E. A. B. Hodgetts, was published in 1909, under the direction of the Explosives Section of the seventh International Congress of Applied Chemistry; the present publication deals with the history of the explosives industry in the United States and Canada, and to some extent in Mexico and South America. It has been written and published under the auspices of the Institute of Makers of Explosives, and the material has been collected from pioneer workers who are still living, from the records and archives of large powder companies, and "for the earlier history, more particularly the origins of the black powder business, data have been found in colonial records and local histories of towns, counties, and states."

The history treats largely of the rise and development of the large powder companies of the United States, with the vicissitudes through which they passed, and it contains biographical details of the personnel of the industry. The technical development is also dealt with. The crude methods of manufacture and control adopted by the early pioneers, with the numerous catastrophes which occurred, have no counterpart in Great Britain, where the first steps of the high explosives industry were controlled by the administration of the Explosives Act of 1875. It is of interest to read that "the use of nitroglycerine as such for blasting purposes was apparently widespread at this time," and that although Congress passed a law in 1866 prescribing the methods of packing and transport, there were many attempts at evasion.

The scope for the employment of high explosives in the rapid opening up of the United States was enormous, and one part of the book gives an account of the different mineral industries which have been developed and of the various engineering projects carried out with the help of explosives. Dynamite was one of the essential materials required for the construction of the Panama Canal; it is recorded

that in the largest individual blast carried out 80,000 pounds of dynamite were used.

The book is divided into six parts, dealing respectively with black powder, nitroglycerine, and dynamite, blasting supplies, including the necessary accessories, detonators and fuses, smokeless powder, including both sporting powders and military powders, military high explosives, largely concerned with trinitrotoluene, and, finally, the part referred to previously, dealing with explosives in the making of America.

The book is well got up; it is profusely illustrated with portraits of those who have been concerned in the development of the industry, and with photographs of factories, plants, and machinery, and of a number of interesting blasting operations and their effects. It will probably not appeal to a wide circle, but will be read with considerable interest by all who have any connexion with the explosives industry.

Our Bookshelf.

The Unconscious in Action: its Influence upon Education. By Barbara Low. Pp. 226. (London: University of London Press, Ltd., 1928.) 5*s*. net.

MISS BARBARA LOW'S "Unconscious in Action" is an attempt to show the importance of psycho-analytic theory in the explanation of character formation. At the same time it is a plea for the use of analysis in the school-room. The author does not, indeed, advocate psycho-analysis of children by their teachers; but she does desire to see the teachers themselves analysed so that, understanding the complex tendencies of their own 'unconscious' and its mechanisms, they may the better appreciate the potentialities for good and evil of the hidden forces lying in the depths of the child-mind. Thus, knowing himself, the teacher will realise the influence of the 'unconscious' upon consciousness, the way in which 'repressions'—fruitful causes of mal-adjustments—are brought about, the dependence of the intellectual life upon the emotional, the rôle of fantasy, and the like; and he will make use of his knowledge in helping the child to adjust himself to reality. Moreover, understanding the 'unconscious' and its mechanisms, he will at least know when to call in the professional analyst as need may arise.

Miss Low is a convinced, orthodox Freudian. Many, acquainted with Freud's teaching in crude, popular, even prurient, vulgarisations, would not allow that the analysis of children could do anything but harm. The popular vogue for psycho-analytic theory and practice has done it thus much disservice. Miss Low, however, is restrained and temperate in what she has to say. She certainly makes out her case for the understanding by the teacher of those forces upon which he plays, knowingly or ignorantly, in his rôle of educator. She makes out a case for the prudent guidance of children along the lines of dynamic psychology. There can be no doubt that education has waited too long for a satisfactory dynamic theory of mind upon which to base its practice. Her theory is Freud's, whose work has done so much to stress the influence of human relationships upon the development of character. But the foundation upon which she builds, notwithstanding Freud's noteworthy contributions to it, is even broader and more solid than the theory of Freud. The details of Freud's views, psychological and philosophical, are still open to criticism; not so, however, his contention, general in modern psychology, of the essentially dynamic nature of the mind.

Creatine and Creatinine. By Prof. Andrew Hunter. (Monographs on Biochemistry.) Pp. vii+281. (London: Longmans, Green and Co., Ltd., 1928.) 14*s*. net.

ALTHOUGH our knowledge of the physiology of creatine, up to within the last year or so, has been remarkably meagre in spite of many investigations on the subject, we are grateful to Prof. Hunter for collecting the data in one volume and critically reviewing the results obtained. It appears probable that recent work on the occurrence of a labile compound of creatine and phosphoric acid in muscle will explain much that has been obscure about the function of creatine in the body, so that the present moment appears opportune for summarising our knowledge and providing a suitable foundation on which future investigators may build.

The author commences his monograph with a description of the discovery, synthesis, and constitution of creatine and creatinine, and then considers the general chemistry of the two compounds and their derivatives. Detailed descriptions of their preparation and quantitative estimation serve as an introduction to an account of their biological distribution: both compounds appear to be confined to vertebrate tissues and completely absent from invertebrate: creatine is found chiefly in the skeletal muscles, probably in labile combination with phosphoric acid, whilst creatinine occurs chiefly in the urine. Creatine is not usually excreted by healthy men, though it occurs as a constituent of the urine in children, in women at certain times, and in certain cases of disease, chiefly of the muscles. The author considers that there is now sufficient evidence to conclude that the urinary creatinine is derived from the muscle creatine, a statement which might have seemed obvious, yet for which direct evidence has been singularly difficult to obtain. It is probable that the conversion of creatine to creatinine is a purely physico-chemical process dependent solely on the temperature and reaction of the tissues, especially the muscles.

It appears certain that creatine has a definite function to perform in the organism and is not simply a waste product: it is presumably derived from protein, possibly from the amino-acid arginine, although its exact precursor has not been definitely determined. The monograph concludes with a

bibliography of thirty pages, the majority of the references having been verified by consultation of the original papers. It should find a place in the library of all physiologists.

Modern Industry. By Prof. Ernest L. Bogart and Prof. Charles E. Landon. (Longmans' Economic Series.) Pp. x + 593. (New York and London: Longmans, Green and Co., Ltd., 1927.) 16*s*. net.

IN their book on "Modern Industry" Messrs. Bogart and Landon have systematised the subject and co-ordinated the various aspects, striving to arrive at, and drive home, their views by the rigid application of a logical decision based upon the consideration of contrary arguments. But whilst admitting their skill, differences of opinion may still arise. They exhibit an American crispness of diction, which is incisive and pleasant, and with much of the text there cannot fail to be agreement; but in some places the authors attempt to prove too much; one example will suffice: "the soldiers, policemen, judges, and others who have maintained peace and order" may all claim a share in the production of any stated sample of manual labour; they would also allot a share to "the owners of the land and buildings where the work is produced," and there are still others to be regarded as co-operators. Such notwithstanding, the book is replete with cogent statements and well-conceived arguments; but no good is effected by depreciating the scientific attainments of past civilisations, in order to enhance the reputation of to-day. The six hundred pages are full of interest, and to very many of us the work will appeal as the gospel of machinery and mass production in contrast with individualism and the satisfaction of human needs as and when they arise. P. L. M.

Our Wonderful Universe: an Easy Introduction to the Study of the Heavens. By Prof. Clarence Augustus Chant. Pp. 191. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1928.) 5*s*. net.

IN spite of the considerable number of elementary works on astronomy, this pleasant little book by Prof. Chant can scarcely be regarded as redundant. It is intended mainly for juveniles, though older people who require a very simple account of the heavens will find it perfectly readable, and will look in vain for pictures of oranges, balls of knitting, lamps, and other similar accessories frequently found in such books. The matter is almost entirely descriptive, dealing with the physical aspects of the heavenly bodies rather than with instruments, methods of observation, or theoretical considerations; an important feature of the book, therefore, as might be expected, lies in its illustrations. There is a large number of well-chosen pictures, among which special mention may be made of some excellent reproductions of planetary photographs taken by Dr. Wright in ultra-violet and red light; but some of the 'bird's-eye' views might be improved by the omission of what appear to be cumulus clouds. By the aid of these illustrations a very clear picture is presented of the universe as conceived by astronomers, and the book can scarcely fail in one of its prime objects, namely, "to excite the wonder of young people, to fire their imagination, and to convey to them some notion of the majesty, the mystery, and the sublimity of it all."

Philips' Pocket Surveyor. Designed by George C. Sherrin. With 16-page Pamphlet. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., 1928.) 2*s*. 6*d*. net.

THE "Pocket Surveyor" is a simple and ingenious mechanism for which it is claimed that it is always ready for 'spotting' levels, calculating heights of buildings and trees, gradients and areas; for setting right angles for sports grounds; for simple map-making and contouring. It is, however, difficult to imagine anyone seriously undertaking these duties with the instrument. The claim seems rather that where these calculations are not a matter of serious concern, the instrument might be used by way of instructional amusement. This is probably true, and one can well imagine "scouts, rovers, cadets, and members of similar organisations" using it as they might any other 'gadget.' The contention, however, that teachers of geography will appreciate the value of this device, "by which simple maps may be constructed, the areas of fields calculated, and the mysteries of contouring unravelled," is surely owing to a fundamental misconception of so-called 'practical geography.' Admittedly, pupils are not expected to produce a finished Ordnance Survey map, but if they do such work at all, apparatus, however simple, should be used which introduces the principles of the standard instruments. To suggest that in any circumstances the "Pocket Surveyor" can do or teach the work of survey instruments is misleading and inadvisable. As an instructive toy it is excellent.

The Geology of Malayan Ore-Deposits. By J. B. Scrivenor. Pp. xv + 216. (London: Macmillan and Co., Ltd., 1928.) 16*s*. net.

THE Malay Peninsula is of especial geological interest both academic and economic. The primary facts regarding it are uncertain owing to the contradictory accounts of Mr. Scrivenor, the Government Geologist, Mr. W. E. Cameron, the former Government Economic Geologist, Dr. W. R. Jones, and Dr. Rastall. Mr. Scrivenor remarks that the confusion "has rarely, if ever, been equalled in geological literature." We therefore turn to this attractive volume in the hope of finding a solution of the difficulties. It should close one of the controversies, for the author abandons his claim for the Permo-Carboniferous age and glacial origin of some boulder beds, and accepts them as modern alluvial deposits. In other respects, however, the issues still remain obscure; for though Mr. Scrivenor remarks that the conclusions in Dr. Rastall's recent papers should be used as a basis of discussion, he is obviously doubtful about them. The author's account does not carry conviction as to whether in Malaya there are two distinct series of granites, and whether some of it is of Upper Mesozoic age. The book leaves some of the fundamental facts of Malay geology in unfortunate uncertainty. It contains a concise and useful account of the chief tin mines.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Radio Echoes and Magnetic Storms.

Prof. Størmer's letter (Nature, Nov. 3, p. 681), on radio echoes heard from 3 to 15 seconds after the signals, raises some interesting points. If the cause is as he suggests, namely, streams of electrons from the sun, associated with auroræ, the observations would seem to give the first direct evidence yet obtained as to the density of these streams, since the reflection of waves of 31·4 metres, at normal incidence (as is necessary for the signals to return to the earth from a great distance), requires an electron density of the order 10^5 to 10^6 per c.c.

Prof. Størmer mentions electrons only, but these must be accompanied by positive ions in approximately equal numbers (assuming them to be singly ionised), since a stream of this order of density, even if it were not practically neutral on emission from the sun, would become so in its passage to the earth, by dispersal of its excess charge. The positive ions will play only a minor part in radio reflection. It is of interest to note that the density of the stream, according to the above estimate, is similar to that of the solar chromosphere. Since the thermal motions of the ions must cause an expansion of the stream during its passage from the sun, the density at emission must be greater.

The fact that the electrons must be accompanied by positive ions will render their motions in the earth's magnetic field very different from those deduced by Prof. Størmer in his valuable mathematical researches on auroræ; Mr. K. C. A. Ferraro and I have made some calculations on this subject, which we hope to publish shortly. The charges in a neutral stream may become separated to some extent by the field, in the earth's neighbourhood, but this can scarcely occur to any extent at the distance of about 200 earth-radii at which the radio signals are supposed to be reflected.

S. Chapman.

Imperial College of Science and Technology,
S.W.7, Nov. 7.

In Nature of Nov. 3 there is a letter by Prof. Størmer which I find exceedingly interesting. Although I have never observed the short wave echoes of 3 to 15 seconds' delay reported by him, I have other observations which bear closely on this matter and seem to afford a striking confirmation of his conclusions. These observations refer to a peculiar class of atmospheric, which from their musical nature are appropriately termed 'whistlers.'

It has been known now for some years that if a telephone or any audio amplifying device is placed in series with a big aerial (eliminating all high frequency circuits and rectifiers), disturbances of a musical character can be heard on appropriate occasions. These can be divided into two classes, the short whistlers and the long, but both are characterised by the fact that the disturbance starts with a note of high pitch, which drops rapidly in the first class and slowly in the second class to a note of low pitch, *i.e.* about 200 to 500 cycles per second. The first have been described by me, *Phil. Mag.*, vol. xlix., June 1925, where it is shown that these disturbances are probably produced by an electrical impulse, the component frequencies of which, travelling with different group velocities in the medium, are drawn out into a disturbance of a musical character.

The resemblance between the long and short whistlers suggests that the mechanism is the same in both cases. The observations which bear on Prof. Størmer's results have been made during the past nine months on the long whistlers. The observations have been made daily, and the following general statements may be made:

(1) Whistlers are definitely associated with magnetic storms. That is to say, the frequency of occurrence of these is enormously greater on magnetically disturbed days than on quiet days. During quiet times days may pass with only occasional 'whistlers.'

(2) On many occasions the whistlers occur in groups of echoes preceded by a violent click. The time interval between the click and first echo is approximately 3 seconds, and between each succeeding echo about 3·80 seconds. As many as seven echoes have been heard. Each succeeding whistler is spread over a longer time than the last. The number of echoes and the time interval between them both vary considerably from time to time.

Although there is not sufficient space in a short letter to go into the significance of these results in detail, the connexion between them and Prof. Størmer's long echo is obvious, and one may assume that the mechanism is the same. One may perhaps surmise that the original pulse is produced by a group of charged atoms shot out by the sun and abruptly stopped at the earth's atmosphere; the resulting pulse spreads into the torroidal ring and circulates round it perhaps five or six times before it is finally extinguished. The region within the ring must be slightly dispersive, an electronic density of about one electron per c.c. being sufficient to draw out the pulse into its spectrum of frequencies. The attenuation must be exceedingly low, which suggests a region of very low density.

Whatever the mechanism may be, it is clear that the two sets of observations confirm each other, for if it is possible to have short wave echoes of 3 or more seconds' delay, the explanation that the 'whistler' is a dispersed pulse delayed in travelling by the same interval of time is clearly feasible.

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The 'Dimensions' of Society.

A remark of Dr. D. A. Robertson was quoted in Nature of Sept. 8 last, p. 383, by the reviewer of the book on "American Universities and Colleges": "When the world's work has been analysed and the skills and qualities required for particular jobs have been specified, the schools and colleges can shape their curricula . . . more . . . effectively. . . ."

Doubtless many methods of analysing men's work can be devised. This note presents a classification in six fundamental categories. These have been selected not by a sociologist but by a physicist. To put forward, however tentatively, a system for cataloguing human activities, in the columns of a periodical devoted to the natural sciences, may seem an anomaly. The justification is this: *logic* and *methodology* are capable of transmitting mutual interactions between the disciplines which deal with Nature and those which deal with man. To the extent that modes of thinking may formally be described, independent of the content of thought, the analytical methods which have been developed in the physical sciences possess general significance.

The passage from empiricism to understanding can

only be accomplished in any field after appropriate categories have been selected for description of the specialised phenomena. The beginnings of modern mechanics are associated with the choice, during the seventeenth century, of what are now called the three 'physical dimensions'—distance, time, and mass—as the essential terms for the description of mechanical events.

Of course, a vast amount of study, following this choice, was necessary before the numerous theoretical and applied formulæ of dynamics were developed. Progress would have been impossible, however, had reliance been placed, in discussions of mechanics, on such fallacious categories as 'fire, air, earth, and water.' For the social sciences (history, political theory, economics, and others), terms of validity and usefulness comparable to the 'physical dimensions' have still to be discovered.

Indeed, it is customary nowadays to doubt whether the logical structure of the social sciences can ever be made as clear-cut as that of physics. Even in an age when concrete results of scientific investigation are beginning to be made everywhere manifest, faith in the existence and power of principles which march with phenomena is still far from general. This much seems certain: the accomplishment or approximation of such a result would have a deep influence on the natural sciences. The brilliance of achievement in these has operated during late years to make unilateral rather than bilateral the interactions between the natural and the social sciences. The mechanistic mode of thought influences our general culture, but the laboratory becomes isolated.

Effective counter tendencies may be expected to develop. Champions of humanism, having found the mace of suppressive legislation, the lance of rhetoric, and the armour of prejudice, alike inadequate to save cherished tenets, must have recourse to the weapons which a modern logic can manufacture. If physicists are true to their traditions, they will criticise with spirit but with tolerance attempts to transcend the logic which has long been supreme in their subject. That logic has usually seemed, to humanists, unduly limited. Nowadays there are indications that it lacks full authority within the bounds of the science of physics itself. As yet it has failed to encompass satisfactorily the *selective* activities associated with the states of atoms.

For more than a dozen years, in a period of intense endeavour, physicists have been constructing an empirical presentation of this 'natural selection' which they observe. We await with interest the transmutation of this empirical presentation into a rational one. Such transmutation may burst the bounds of the old logic: the selection which is in Nature may not be 'natural' in the traditional sense.

If this is indeed the case, the situation does not lack parallels with the situation which existed at the time when the founders of modern science were struggling to free their thought from the limitations of medieval dialectic. We cannot as yet decide. Whatever the outcome, investigators of philosophical trend are not untrue to the scientific spirit if their search for new modes of picturing the realities of physics leads them to examine a variety of data conventionally regarded as irrelevant.

Remembering that observation, not prophecy, is the test of hypothesis in the sciences, we return to the principal thesis of this note. The following list of 'essential' terms is justified in the degree that it permits a co-ordinated view of the entire field of purposeful (or selective) behaviour of men and women, to whom civilisation is more precious than appetite.

TABLE OF OCCUPATIONS WHICH TYPIFY THE 'DIMENSIONS' OF SOCIETY.

	Objective.	*Organising.*	*Æsthetic.*
(1)	Labourers	Adventurers	Sportsmen
(2)	Artisans and clerks	Foremen	Connoisseurs
(3)	Scientists and scholars	Engineers and 'executives'	Critics
(A)	Inventors	'Entrepreneurs' or 'promoters'	Decorators
(B)	Legislators and jurists	Statesmen (on whatever scale)	Educators
(C)	Philosophers	Religious leaders	Artists

Each of the terms in the list is to be understood in its ideal and abstract sense. For example, many active members of a given legislature may not be qualified as legislators; while much work that must be done by investigators in science falls under 'labour,' or 'craftsmanship,' or 'invention,' or 'adventure.' The shortcomings of words when employed as mathematical symbols are such that at least a paragraph would be required to clarify the meaning of each term employed.

In so far as this classification is accurate and inclusive, it is an aid for criticism or construction of definitions of 'progress,' of ideas of civilisation, of political and social programmes, schemes of education, evaluations of individuals, and the like. Phases of human activity should be analysable into 'components' along each of the 'dimensions,' just as the geometer resolves the curves of a sculptured masterpiece into x, y, and z components in space.

In so far as this classification represents an outcropping of a generalised logic, which is capable of dealing with values as well as with facts, it possesses very broad implications. JOHN Q. STEWART.

Princeton, N.J.

The Immunity to Adder Venom of Slow-worms, Frogs, and Toads.

IT is commonly believed that all creatures are subject to the destructive propensities of snake venom. I have, however, been able to show that two or three species, at any rate, in the animal kingdom are immune to adder poison.

Some time ago I carried out a series of experiments to ascertain and determine the effect of adder bites on frogs. I experimented on three different frogs with three different adders, and the result in each case was that the venom had no apparent physical effect on these creatures. There could be no doubt whatever of the fangs penetrating the skin, because the reptiles bit the frogs so viciously, and the fangs were driven home with such force, that the adders had some difficulty in withdrawing them. Therefore the inoculation was an absolute certainty. I was so astonished at the negative result of my experiment that I began to suspect that the mechanism of the poison apparatus must have been defective or faulty, although this would have been most unlikely to happen in three different specimens.

I decided to submit my experiment to a final test. Accordingly, I experimented with one of the adders above referred to, on a large brown rat. The adder bit the rat on the upper part of the left hindleg, and practically simultaneously with the bite the hind quarters of the rat became paralysed, rendering the creature quite helpless. It lived for an hour and a quarter after being bitten; the respiration became faulty and spasmodic, gradually slowing down until the animal died of slow suffocation. The venom of

the adder contains a high degree of blood-destroying element, which involves the disorganisation of the nerve centres which govern respiration.

I have also carried out a similar experiment with toads, and the result in each case was exactly the same as in the case of the frogs. Moreover, I made microscopic slides of toad's blood mixed with adder venom. A microscopic examination of the slides shows the corpuscles intact—quite normal (Figs. 1 and 2). I

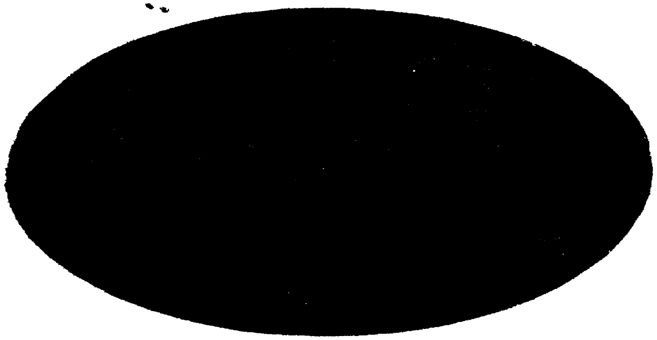

FIG. 1.—Toad's blood, showing corpuscles intact after infection with adder venom.

have already mentioned that the poison is a blood-destroying or hæmolytic element. Therefore, the corpuscles in the toad's blood, after being subjected to an injection of adder poison, should have been disintegrated and destroyed.

My next experiment was with slow-worms (*Anguis fragilis*). I allowed two slow-worms to be bitten

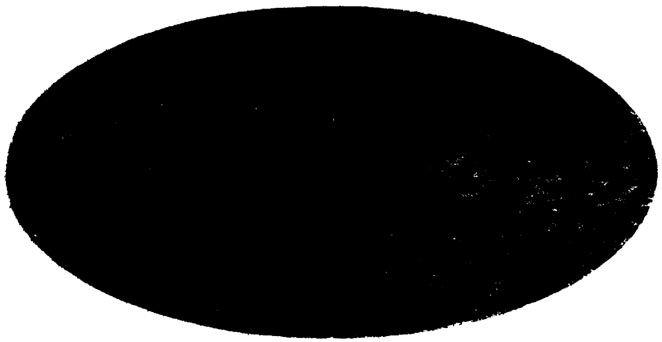

FIG. 2.—Toad's blood, normal.

repeatedly by three different adders, yet the poison had no physical effect whatever on these reptiles. They lived with me in captivity for weeks afterwards, and became quite tame. Microscopic examination of the infected blood stained with hæmatoxylin showed the nuclei much enlarged—otherwise the corpuscles were intact.

I have also submitted a lizard to the fangs of an adder, and the creature was dead twelve minutes exactly after being bitten. It is interesting to note that the slow-worm and the lizard (*Lacerta vivipara*) are, zoologically speaking, first cousins; that is, they belong to the same family (sub-order Lacertilia). Still, the former is immune to the lethal action of adder venom, while the latter succumbs to its deadly potency.

This strange immunity suggests that the blood of the frog, toad, and slow-worm contains a powerful antitoxin element which immediately neutralises the action of the adder poison, or it may be partly due to a dermal arrest.

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Evidence of Survival of a Human Personality.

WILL you permit an old student of ancient and modern psychical phenomena, and a staunch supporter of modern experimental science, to make the following observations on Dr. Tillyard's letter and the editor's comments thereon in NATURE of Oct. 20 (pp. 606-7)?

1. Men of science rightly demand that they should control the experiments, but they seem unable to suggest in what way the method by which experiments are conducted should be revised; and until they know more about the laws controlling the matter involved in the phenomena, they will not be in a position to do so. "The novel atmosphere of the séance room and the unexpected events that take place there," should suggest novel and unusual methods of procedure. As the methods of control used in *physical* experiments vary with the nature of the physical energies under examination, so the methods of control in *psychical* experiments should be adapted to the energies operating in such phenomena.

2. Opinions may and do vary as to the adequacy of the 'tests' to prevent fraud, but such tests, however necessary, are purely negative and preliminary, and have nothing whatever to do with the real science of the problem—if 'science' means control of Nature by knowledge of her 'laws.'

3. Isolation is the fundamental requirement in scientific experiment, but we have not discovered what provides the necessary isolation for the creation and growth of organisms. The inner polar conditions of the organism itself must isolate it and adjust the operations of Nature. Every normal human being must be automatically isolated in the same way as animals, or their forms could not be preserved; and a man must be isolated also mentally (or psychically) to maintain his individuality. How is this done? What is the result if the isolation be broken through, the polar balance disturbed? How can it be restored? I think these questions are pertinent to mediumistic phenomena.

4. Mere reflection on what we already know from scientific research regarding the principles and processes of creation should lead to a comprehension of the utter worthlessness of resemblance in a 'materialised spirit' as a proof of identity: the possible reproductive, reflective, and imitative powers of Nature seem limitless. If electrical energy can record and echo our voices, why cannot it reproduce and echo our thoughts?

W. W. L.

Oct. 20.

[THE points raised by W. W. L. in the above letter go to the root of certain of the difficulties inherent in psychical research. The duty of the scientific man is to attempt to discover the causes of so-called psychic phenomena; to ascertain the 'laws' which govern them, and then to form some theory which can be said properly to describe them. Working hypotheses are excellent, but they should at least be brought as near as possible to the known world before seeking help in the unknown.

The methods of investigating mediums must naturally be adapted to circumstances, since, as in experimental psychology, the human factor is concerned. But at present the investigations, if they can be called such, are carried out under the necessity of obeying sets of purely arbitrary and unproven 'laws,' invented by spiritualists and others, of which the chief result seems to be to prevent exact knowledge being acquired.

Doubtless it is possible, although in our opinion improbable, that psychic phenomena can only occur under conditions which render it impossible to ascertain their real nature. It may be that, in the case of experimental telepathy, for example, if we exclude normal processes such as codes, etc., the supernormal element cannot come into operation. If this be so, it is clear that science must prefer the theory that normal causes are sufficient, even though it may be difficult to determine precisely at each point what kind of normal factor is active.

Until we know more of the unknown elements said to be present in psychic phenomena, it is premature to discuss theoretical considerations. Knowledge can only be obtained by careful systematic investigation, by free, unhindered inquiry, and by exact and varied experiment. When results are obtained under these conditions which can be compared and verified in a number of cases, it will be time to determine whether the extension in our knowledge demands an appeal to extra-mundane influences.—THE EDITOR.]

Active Nitrogen.

IN a brief discussion of active nitrogen in NATURE of Sept. 15, by Mr. C. N. Hinshelwood, there are several statements which should be modified in view of some recent work done by several investigators.

The statement is made in the article: "In the presence of more than about 2 per cent oxygen, the nitrogen does not glow at all." This has been shown to be wrong. I have shown that active nitrogen is produced when a condensed discharge is passed through air at 0·5 mm. pressure (*Proc. Nat. Acad. Sci.*, **14**, 258; 1928). Herzberg (*Zeit. f. Physik*, **46**, 878; 1928) showed that it was possible to produce glowing active nitrogen in mixtures of nitrogen and oxygen in which the percentage of nitrogen varied from 100 per cent to 40 per cent. Earlier than either of the above experimenters, Hagenbach and Frey (*Phys. Zeits.*, **18**, 144; 1917) showed that glowing active nitrogen could be produced from air. The spectra observed by all these authors was the same as that obtained from active nitrogen that has been produced from almost pure nitrogen.

Elsewhere in Mr. Hinshelwood's article the statement is made that a few of the first positive bands of nitrogen are prominent in the afterglow and "the rest entirely absent." Rayleigh observed in one of his earlier spectroscopic investigations of active nitrogen (*Proc. Royal Soc.*, **85**, 377; 1911) that in addition to the very prominent bands in the afterglow, other bands of the *a* group appeared. At the time that these bands were observed, Rayleigh ascribed them to stray light from the discharge tube or to stray discharges. In a later paper (*Proc. Royal Soc.*, **102**, 453; 1922) Rayleigh photographed these bands again, and definitely assigned them to the afterglow. During the past year Dr. G. Cario and I have photographed the afterglow in the visible and in the near infra-red, and it has been found that practically the entire first positive group of nitrogen is present in the afterglow. The idea, therefore, that the afterglow spectrum consists of only a few selected bands of the first positive group is wrong. A full account of this work is to appear soon.

We wish further to discuss the statement that th[e] assumption of metastable nitrogen molecules in th[e] afterglow must be made "directly for the purpose o[f] explaining the facts, and without independent evi[-] dence." The first electronic level of the nitroge[n] molecule is known as the *A* level and possesses abou[t] 8 volts energy. This level has long been suspecte[d] of metastability because of the absence of transition[s] between it and the normal level in either emission o[r] absorption. The absence of these transitions is i[n] agreement with the assignment of the *A* level to th[e] triplet system and the normal level to the singlet system, since intercombinations are highly improbable. Other experimental evidence as to the existence of metastable molecules in active nitrogen has been given by me (*Phys. Rev.*, **31**, 1126; 1928). Both of these pieces of evidence are independent of any theory as to the nature of active nitrogen and should therefore be considered in proposing any explanation of active nitrogen.

JOSEPH KAPLAN.
Department of Physics,
University of California,
Los Angeles, Cal., Oct. 6.

IT is interesting to know that under certain conditions the glow can be produced in presence of air: the fact, however, remains that under those used by Lord Rayleigh oxygen destroyed it.

I take it Dr. Kaplan does not suggest that the *prominent* bands are other than those described by Rayleigh, or that the intensity relationships are not much displaced. This still seems the most important fact, though it is also interesting that the other bands can be found. Dr. Kaplan does not mention the intensities of the bands he and Dr. Cario find. Presumably they are very faint.

I have not yet read Dr. Kaplan's paper in the *Physical Review* of 1928: but the first piece of evidence mentioned does not seem to me to be more than a suggestive analogy. I agree at least that it is that.

C. N. HINSHELWOOD.

Secondary Absorption Edges in X-rays.

RECENTLY Nuttall (*Phys. Rev.*, **31**; 1928) has examined the X-ray absorption spectra of simple compounds like potassium chloride and found six absorption edges (designated as *A*, *B*, *C*, *D*, *E*, and *F*) both for potassium and chlorine atoms, all of which lie on the short wave-length side of the primary *K*-limit. The wave-lengths of the first four of these agree well with those found by Lindh in chlorine compounds of different valencies.

Following the well-known theory of Kossel that the fine structure limit should in no case exceed the ionisation potential of the atom, Coster, Robinson, Stoner, Lindsay, and others have tried to explain the secondary edges which lie outside the fine structure limit as due to the multiple ionisation of the atom. On this view, then, the frequency of the characteristic emission lines of these ionised atoms will be changed so much as to be clearly resolved by the spectrograph (Ray, *Phil. Mag.*, vol. 1; 1925), but no such large shift in emission has yet been observed. Thus neither the valency nor the ionisation theory explains satisfactorily the presence of these absorption edges. I believe that a simple explanation of these observed phenomena can be given on the following lines:

In the ordinary absorption phenomena the energy in the incident radiation is utilised in removing an electron from one of the energy levels (say *K* level) to levels which lie beyond the periphery of the atom. Radiation of higher frequencies is also absorbed and

the excess of energy is utilised in imparting kinetic energy to the ejected electron. In order to explain the secondary absorption it is assumed that not only can a quantum of radiation be absorbed by a single electron in an atom, but also that the same quantum can be absorbed successively by two or more electrons occupying different energy levels in the atom. Those quanta which can thus successively remove two or more electrons (say one from the K and the other from the M level) out of the atom, will be selectively absorbed and will therefore appear as absorption edges on the shorter wave-length side of the primary K limit.

The process of first absorption of the incident quantum by the atom mainly determines the position of the secondary edge and may take place in a number of ways. Thus the incident quanta may knock an electron from the valency or from the $M_2(M_{II}, M_{III})$ or from the M_1 shell, either to some higher optical level or to infinity (zero energy), or may raise the electron from M_1 to M_2 level, if there is any space for it, and thus give rise to a number of possibilities for the appearance of the secondary K edges. From the interpolated values of higher levels of the atom from X-ray and from optical data, a rough calculation is made of the shift of these edges, and the following table shows the observed (Nuttall) and the values calculated according to the point of view taken in this paper for chlorine. Here the combinations are of the types, ν_K, $\nu_K + \nu_{R_\infty}$, $\nu_K + \nu_{M_2} - \nu_R$, $\nu_K + \nu_{M_2}$, $\nu_K + \nu_{M_1} - \nu_{M_2}$ and $\nu_K + \nu_{M_1}$, where the subscripts K, M_1, and M_2 denote energy for K, M_1, and M_2 shells, R the resonance level (optical), and R_∞ the change from resonance level to infinity.

	$A-B$	$A-C$	$A-D$	$A-E$	$A-F$	$A\rightarrow$
Observed	4·0 v.	10·9 v.	15·5 v.	19·2 v.	27·3 v.	above 50 v.
Calculated	4·2 v.	8·9 v.	13·4 v.	17·6 v.	27·4 v.	,, 40 v.

Similar calculations have also been made in the case of potassium and calcium in close agreement with the observed values of Lindsay and Van Dyke (*Phys. Rev.*, **28**; 1926). Details of the calculations, the mechanism of double absorption, and also the question of intensity will be dealt with in a subsequent communication.

B. B. RAY.

University College of Science,
Calcutta, Sept. 27.

An Experimental Test of Schrödinger's Theory.

ACCORDING to Schrödinger's theory, the intensity of an expectral line in emission is not determined by the number of atoms in the higher level and the coefficient of expontaneous emission, but by the populations of both the higher and the lower levels corresponding to that line. If we have then two lines emitted by the same higher level, their relative intensity ought to change if we change the relative population of the lower levels, and furthermore, the change in the relative intensity of the lines should be equal to the change of the relative populations.

This conclusion has been tested experimentally, using mercury vapour at room temperature, optically excited, in which the two lines 4358 A. and 4046 A. emitted by the same higher level 2^3S_1 appear in fluorescence with great intensity. The relative population of the two lower levels 2^3P_1 and 2^3P_0 can be changed several hundred times by introducing a few millimetres of nitrogen or water vapour into the tube containing the mercury vapour. In fact, when mercury vapour alone is in the tube, the absorption of 4358 is several times stronger than the absorption of 4046, showing that the population of the resonance level is several times greater than the population of the metastable level; if a few millimetres of nitrogen or water vapour are now admitted in the tube, 4046 is very strongly absorbed and the intensity of the lines 4358 and 4046 in fluorescence increases about twenty-five times as found by R. W. Wood. A simple calculation shows that the number of metastable atoms must be now at least 100 times larger than the number of resonance atoms (see E. Gaviola, "The Influence of Foreign Gases on the Optical Excitation of Mercury," appearing in *Phil. Mag.*).

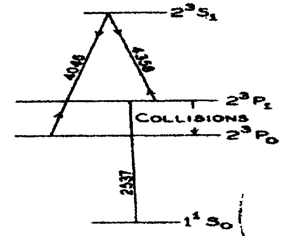

FIG. 1.

The enormous increase in the number of metastable atoms is due to the fact that collisions of the second kind with foreign gas molecules bring resonance atoms down to the metastable level, where they accumulate owing to the long mean life of this level. The relative population of the two lower levels has changed, then, at least several hundred times, due to the admission of gases, and, according to the theory, the ratio of the intensities of the lines 4358 and 4046 in fluorescence should also change in the same proportion. This ratio has been carefully measured without and with foreign gases, avoiding re-absorption of the fluorescence lines in the excited vapour by using a very narrow beam of primary light, and choosing such a pressure of the foreign gas that metastable atoms do not diffuse out of the illuminated region, and the result is that the ratio mentioned is equal to 2 in the case of mercury alone and equals 2 in the presence of nitrogen or water vapour. This proves conclusively that in our case the ratio of the intensities of the lines in emission does not depend on the populations of the lower levels, in contradiction with the common interpretation of Schrödinger's theory.

Details of calculations and measurements will appear in another place.

The experimental part of this investigation was done in Prof. R. W. Wood's laboratory in the Johns Hopkins University.

E. GAVIOLA.

Department of Terrestrial Magnetism,
Carnegie Institution of Washington,
Oct. 6.

Work and Place of Amateurs in Science.

IN NATURE of Aug. 18, under the heading of "Biography in American Science," attention is directed to the scarcity of amateur scientists, that is, to that class of them who have reached some degree of success in research. The word amateur, however, in its common meaning is applied to a large number of persons who are inexperienced and with only a superficial knowledge of the subject. Most of these are entirely different from the amateurs referred to in the article in NATURE, and we need to coin a new word or term to designate the amateur scientists who are experienced in research and have a broad knowledge of the subject.

The word amateur in its strict and original meaning is rather complimentary. But in our dictionaries, immediately following the word amateur is the word amateurish, which is defined as "Superficial or defective like the work of an amateur." So this definition is a rather uncomplimentary reflection on the amateurs.

The term amateur scientist as it is commonly understood might include all persons who are naturally interested in some scientific subject and make a study of it; the time devoted to it and their knowledge of their subject may vary greatly with different

individuals. There are others whose interest is only indirect; thus an amateur might make entomology his hobby, while his real interest is in the enjoyment of the excursions to the country. There is also a large group who have but little originality or interest in science for the sake of truth, but dabble into some subject expecting to take it up as an occupation later. All this is more or less creditable to these amateurs, but does not make them scientists.

The amateur scientists referred to in the article in NATURE, who not only pursue science for the interest in the subject itself and without compensation, and also put in their money to carry on their research, are different from the ordinary amateurs in having a deeper knowledge of their subject and in being experienced in the research and special study of the subject; they may be even more experienced in their special subject than many professional men of science, except the few who also make a special study of the same subject.

There is a tendency to discourage and ignore the theories and discoveries of unknown amateur scientists. A discovery should be judged only by its importance in fundamental truth. The proper understanding of Nature and the discovery of the laws of Nature is a gift that is exceedingly rare, and it should be recognised wherever found, whether in the ranks of the professional men of science or in the ranks of the amateur scientist.

Research and discoveries, however, should not necessarily be expected of all teachers of science and other professional men of science; they both render great service to science in their profession, one by the teaching of it, the other by its practical application to modern improvements and the benefit to mankind. In the meantime, a few professional men of science can render unusually great service by making discoveries in fundamental truth.

J. T. WATTS.

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Chicago, Illinois.

The Planets Mercury and Venus.

THROUGH the kindness of Dr. Deslandres, I followed Mercury here last spring and summer with the 33-inch refractor, and all recent observations confirm my 1927 results with the same instrument as to the correctness of the 88-day rotation period and as to the presence of whitish atmospheric veils of low albedo, which occasionally distort and conceal the subjacent dusky areas. The axis of rotation of Mercury cannot of course coincide exactly with the perpendicular to the orbital plane, although it cannot form a considerable angle with it.

The experience gained by the use of the 33-inch refractor and the comparison of my data with those of many observers using all sizes of instruments, show that reduced diffraction in large telescopes not only broadens the dark interval between the components of double stars and Cassini's division in Saturn's ring, but that it also increases the size of all dusky planetary markings, such as the so-called seas and irregular streaks of Mars, or the belts and dark spots of Jupiter and Saturn. In the case of the minute disc of Mercury, the agency of diffraction, which causes luminous areas to encroach upon the small or narrow greyish spots, tends to bring about the extinction and invisibility of the latter. For this reason I cannot detect them with an aperture of 6 inches.

The discovery of the long rotation period of Mercury with a refractor of only $8\frac{1}{4}$ inches by Schiaparelli must thus be considered as a wonderful feat of observation, and this the more so as the appearanc of the dusky markings of the planet is frequentl modified by the interposition of the above-mentione whitish veils, the existence of which did not elud the acuteness of the distinguished Italian astronome

I have also studied the planet Venus systematicall with the large instrument, but the markings seen wer of such a nature as to render impossible any con clusion concerning the period of rotation of th planet.

E. M. ANTONIADI.

Observatoire de Meudon (S.-et-O.),
France, Oct. 16.

Laboratory Drainage.

TROUBLE with laboratory drainage is so frequent that information on any new departure may be of general interest. It is difficult to obtain a material for waste systems which will withstand dilute acids, alkalis, organic liquids, and mercury, all of which find their way down chemical drains. So far, glazed ware pipes remain the best things for general use, but can only be obtained in very short lengths, involving an undesirable number of joints. I have tried to interest one or two firms in the production of moulded drains and channels of graded silica (sand) and asbestos bound together by high silica sodium silicate, but the demand does not appear to inspire much enthusiasm for research in this direction. Thanks to a professor in one of our universities, some alloys of nickel are under test in his laboratory drainage system, with a view to the possible use of this material.

A more recent departure is the use of vulcanite, and an enterprising firm has had made a vulcanite four-inch channel ten feet long which has been in use in another institution for three months, during which short period no change is discernible; but whether such a channel would withstand the severe conditions of some organic laboratories may be open to question.

Should any reader of NATURE be prepared to follow up this subject in the interests of advancing laboratory construction, I shall be glad if he will communicate with me.

ALAN E. MUNBY.

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Higher Hydrocarbons from Methane.

IN view of the publication by Fischer (*Brenn. Chem.*, **9**, 309; 1928) of the results of his experiments on the thermal decomposition of methane, to which reference is made by Messrs. Stanley and Nash in a letter published in NATURE of Nov. 10, it seems desirable to place on record the fact that the production of commercial yields of benzene by the pyrolysis of methane, without a catalyst, was proved in the Fuel Technology laboratories of the University of Sheffield about two years ago. The work forms the basis of certain claims in English Patent No. 26719 of Oct. 8, 1927.

For reasons which will appear in a forthcoming publication, I believe the production of benzene during the decomposition of methane to be through ethylene, which is an early product of decomposition, and butadiene, which ethylene yields on heating. The formation of ethylene from methane can be expressed as follows: $CH_3 \cdot H \longrightarrow :CH_2 + H \cdot H$, two of the 'residues' $:CH_2$ postulated by Bone and Coward (*J. Chem. Soc.*, **93**, 1197; 1908) combining to form ethylene.

R. V. WHEELER.

Department of Fuel Technology,
University, Sheffield,
Nov. 12.

Infra-red Absorption Spectra of Ammonia, Phosphine, and Arsine.

IN the *Proceedings of the Royal Society* for August (vol. 120, pp. 128-210) will be found a series of communications from the Government Laboratory on the infra-red spectra of the three gases, ammonia, phosphine, and arsine, by Sir Robert Robertson and Dr. J. J. Fox.

In the first two papers of this series are described in some detail the apparatus and arrangement, as it was represented to the authors that it would be of interest to others working in this field to give an account of their technique. In the third paper are given numerical data at gas pressures of 1, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$ atm. for the position of the oscillation bands, and for the rotation-oscillation bands when they have been resolved, together with curves illustrating these. The fourth paper contains a discussion of the molecular structure of the three gases as deduced from their band spectra.

A Hilger No. 2 infra-red spectrometer with wavelength drum engraved for a rock-salt prism was used. Both to calibrate the engraving of the drum and to obtain the values of the markings for use with prisms of quartz (up to 3 μ) and of fluorite (from 3 μ to 8 μ), these values were experimentally determined in terms of angles of rotation of the prism table. It is considered that when prisms of different materials are employed, engraving on the drum would have been more convenient if it had been in terms of angles. To obviate the effect of variations of air pressure on the thermopile, this was enclosed in a specially designed air-tight casing with rock-salt windows.

In work in the infra-red region, the importance of taking into account the high temperature coefficient of refractive index of rock-salt and also of fluorite has been insufficiently recognised. This temperature coefficient has been determined by Liebreich, and as Sir Robert Robertson and Dr. Fox have already directed attention to this subject in this journal (NATURE, June 4, 1927, p. 818) it is sufficient to say that not only was the temperature of the prism taken periodically throughout each experiment and allowance made for any deviation from a standard temperature of 18° C., but also as a working basis Paschen's values for the refractive indices of rock-salt and fluorite were referred to the same standard temperature, tables for this conversion being given in the paper. Most published tables of refractive indices of rock-salt and fluorite have ignored the fact that Paschen's determinations were made at varying temperatures.

A galvanometer of very high sensitiveness was used for registering the energy falling upon the thermopile, and to overcome the effects of electromagnetic disturbances and mechanical vibrations on this instrument constituted some of the chief difficulties of this research. By suitable shielding with 'stalloy' and 'mu metal' the former disturbances were overcome, whilst the mechanical disturbances were nullified by a suspension system which rendered the galvanometer usable at all times, even in a neighbourhood affected by continuous heavy road traffic.

The gases, prepared in a pure state, were passed into one of two observation tubes fitted with rock-salt end-plates, the other tube remaining empty, and these tubes were brought by means of a rocker device alternately into the optical train of radiation from a Nernst filament to which the input of energy was accurately controlled. Observations were made of the energy as it passed first through the empty tube and then through the tube containing gas. This arrangement was preferred to the alternative method of employing one observation tube and exploring sections of the spectrum through this tube when it is alternately empty and filled with gas. In the compensating tube method it is essential that the ends of both tubes shall be in strictly accurate optical alignment.

In all three gases, ammonia, phosphine, and arsine, a main sequence of harmonic oscillation bands is disclosed, but while such a regular departure from true harmonic ratio as Kratzer found in the case of the harmonic oscillation bands of hydrogen chloride is not found in any one of the three individual gases, nearly constant ratios are obtained between each of the corresponding harmonic members of the several gases. The following table illustrates the degree of uniformity of these ratios in the case of the main sequence of oscillation bands:

Band.	Wave Number.			Ratio.	
	Ammonia.	Phosphine.	Arsine.	Phosphine/ Ammonia.	Arsine/ Phosphine.
I.	1630·9	1125·0	1005·4	0·689	0·893
II.	3335·6	2327·2	2121·9	0·697	0·911
III.	5083·9	3413·7	3091·2	0·672	0·905
IV.	6609·4	4560·0	4161·5	0·689	0·912
V.	8250·8	5608·5	5125·6	0·680	0·914
				Mean 0·685	Mean 0·907

The rate of oscillation thus depends upon the mass of the nucleus of the heavy atom of the molecule, and doubtless by assuming a suitable law of force the distance of the atoms from one another could be calculated. It affords also an argument for a similar structure for the molecules of the three gases.

In addition, each of the three gases was found to have a second sequence of harmonics, and phosphine and arsine a sequence peculiar to themselves. Further, there appeared in ammonia a band at 10·55 μ, apparently without harmonics, and members of a series of what were considered to belong to one mode of rotation of the molecules of that gas.

The oscillation frequencies become slower in the order, from ammonia to phosphine and phosphine to arsine, and the wave-number differences in the rotation bands show that the molecules also rotate more and more slowly in the same order.

Consideration is given in the fourth paper to the bearing as regards constitution of the data displayed in the previous paper. The occurrence of harmonics in the oscillation bands has already been

mentioned, and this is considered in conjunction with the determination of the electric moment of the three gases and the temperature coefficient of their dielectric constants as determined by Watson on samples of the same gases.

Hund, from a consideration of the polarisation and laws of force in the case of the ammonia molecule, concluded that when the polarisation reached an equilibrium position, the four ions forming a tetrahedron with equal side faces, this figure was stable. That the ions are separating is shown by the presence of the oscillation bands, and one of the modes of vibration is that of the nitrogen atom against the plane of hydrogen atoms. Hund's condition would then be fulfilled and a tetrahedral structure required for the model. In the case of ammonia and of phosphine, Watson's values for the electric moment clearly support such a view, but in the case of arsine he gets a small value for this and for the temperature coefficient of its dielectric constant. Absorption bands as strong as those of phosphine are found in the spectrum of arsine, and it is argued that the electric moment should not be reckoned as directly measured by the product of the distance of the heavy atom from the three hydrogen atoms and the charges on the ions, but that the effect of the electron shroud, greater in the case of the heaviest of the atoms

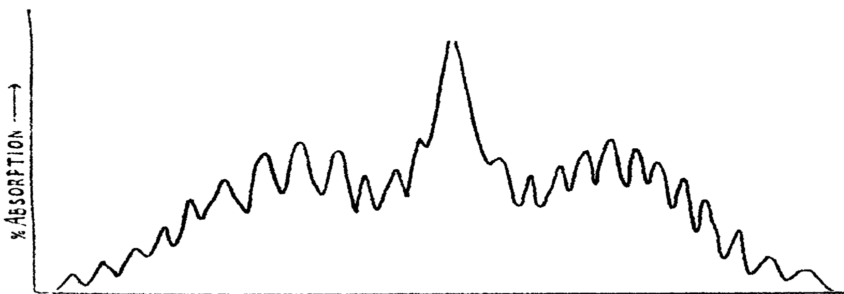

FIG. 1.—Typical band of ammonia, phosphine, or arsine.

(arsenic), comes into play, acting in the opposite direction to the original electric moment. Thus a tetrahedral structure is deduced for all three molecules, though not necessarily of equal height.

Since, in addition to the main sequence of harmonic oscillation bands mentioned above, there occur other sequences, some speculations are made, especially in the case of ammonia, as to the degrees of freedom of the atoms in that molecule of which these sequences may be the reflection. Thus arguments are adduced for assigning the oscillation that may give rise to the band at 10·55 μ, and for the peculiar sequence of bands of ammonia of which members of a harmonic series appear with the first two members of the sequence absent. The evidence as a whole from these considerations is much more in favour of a tertahedral than of a coplanar configuration for the molecules of these gases.

While it is recognised that the existence of optically active forms of substituted ammonium

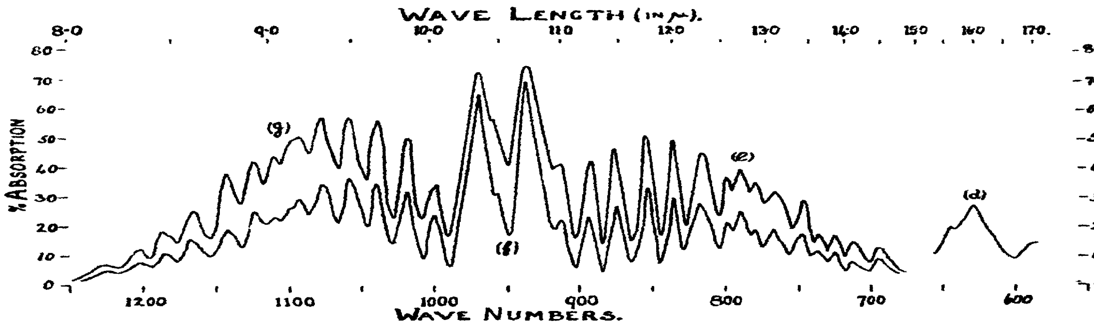

FIG. 2.—Band of ammonia at 10·55 μ. Upper curve at $\frac{1}{2}$ atmosphere, lower curve at $\frac{1}{4}$ atmosphere.

compounds is not decisive on this point, on account of the disturbance caused by the substituting groups, at the same time the work of Ellis and Salant on the infra-red spectrum of amino- and imino-compounds points to the N-H oscillation being connected with what is termed above the main sequence of harmonics, and this view does not conflict with the attribution of other degrees of freedom, some of which correspond to valency bonds, to the other series of oscillation bands in ammonia.

No oscillation bands have been found in these gases similar to that found (and resolved) by Imes and others for hydrogen chloride and characterised by what may be termed P and R branches, with a missing Q or central branch. As a rule, the oscillation bands of ammonia, phosphine, and arsine have P and R branches with a bold central Q branch of absorption. They are usually of the type shown in Fig. 1, which shows a band in which the P and R branches have been resolved to give the rotation fringes.

From the wave number differences, which vary little from band to band for each of the gases, the moment of inertia has been calculated from $\frac{nh}{4\pi^2\Delta_1}$, and J has also been calculated from the classical energy relation $\frac{1}{2}J(2\pi\nu)^2 = \frac{3}{2}kT$, ν in this case being the mean difference between the peaks of the Q and the P and R branches. In the following table are given the results of these calculations:

	$J_1 \times 10^{40}$ from Band Structure.	$J_2 \times 10^{40}$ from Energy Relations.
Ammonia . . .	2·78	3·49
Phosphine . . .	4·78	6·24
Arsine	5·53 or 6·51	8·28

The radius of gyration is also calculated from the former set of values of J and compared with those of Rankine, whose radius of mean collision area, as would naturally be expected, is greater than that of the radius of gyration.

The moments of inertia obtained above are thought to have reference to the rotation of the molecule about a line at right angles to the line dropped from the heavy atom on to the plane of the hydrogen atoms and passing through the centre of mass, but in the case of ammonia another and smaller moment of inertia was discovered ($J = 0 \cdot 35 \times 10^{-40}$). This emerged from a consideration of the band at $10 \cdot 55\ \mu$ mentioned above, which forms an exception to the usual tripartite bands in these gases. It is shown in Fig. 2. Thus it has a double Q branch, cloven, with a missing rotation member reminiscent of the bands of the halogen hydrides. The wave-number spacing between most of the rotation fringes is similar to that occurring in bands of the main sequence of bands of ammonia, but there are exceptions, or disturbances. The wave-number difference between the disturbance on the R branch (g) and the centre of the two Q branches (f), thence to a disturbance on the P branch (e), and thence to an isolated band beyond (d), is 160 wave-numbers, this last band having a wave-number four times that of a so-called rotation band of ammonia found by Rubens and Wartenberg about 160 wave-numbers ($63\ \mu$). It is therefore considered that there is here the imposition of another rotation system, and as its moment of inertia is much less, it is attributed to the rotation of the hydrogen atoms round a line dropped perpendicularly from the nitrogen on to the plane of the hydrogen atoms.

Finally, it may be said that while the structure of the three molecules, ammonia, phosphine, and arsine appears to be essentially similar, yet there are features in the infra-red absorption spectrum of ammonia which differ from those of the other two, and while the spectra of phosphine are very like one another, yet they themselves have features not possessed by ammonia.

As most of the work on these gases was conducted at pressures varying from one to one-sixteenth atmosphere, an opportunity was affor of observing the effect of pressure on the intensity and on the area of the bands. In view of statements in the literature that such a law as that of Beer, which provides for an exponential decrement of intensity with pressure, does not hold for such a case as this, it was of interest to find that when the bands were well resolved this law was obeyed with remarkable accuracy. This would point to the absorption of the imposed radiation by a comparatively small fraction of the total number of molecules present in the gas.

Health and Sanitation in India.

AN Appendix to the Report of the Royal Commission on Agriculture in India has recently been published,[1] consisting of a concise survey of conditions in each of the presidencies and provinces, eleven in all, of British India. One section of each such survey is devoted to public health and sanitation, and of these it is proposed to give a brief account. The Native States are not included in the survey.

The chief feature brought out by these sections of the volume is the tremendously heavy incidence of certain microbic diseases, such as malaria, cholera, and kala-azar, and the high mortality, or in the case of malaria, the severe deterioration in physical well-being and efficiency caused by them.

As regards malaria, the official figures of deaths directly due to this disease are undoubtedly far too high. Thus in the United Provinces about one million (out of a population of 46½ millions) are reported as dying every year of malaria; but "the village watchman [who is the registration authority] ascribes every case of death which he cannot understand to malaria"; still, the actual number of deaths cannot be less than 100,000 annually. The importance of malaria, however, lies rather (apart from the actual suffering) in the reduction of working efficiency, and in its being a predisposing cause of death from other diseases. Thus (again in the United Provinces) one-fourth of the total population get two attacks of malaria every year, and only 1 per cent receive proper quinine treatment; 25 per cent of the population are totally incapacitated for work for two months, besides having a lowered vitality for the rest of the year. The loss of efficiency for the 18 million workers in the agricultural population of 35 millions is put down at 50 per cent.

For six months of the year the delta of Lower Burma is practically entirely under water, and for months afterwards, shallow pools are left scattered about the country. What this must mean for malaria is easily apprehended; and it is not surprising to learn that malaria undoubtedly reduces the working efficiency of a large part of the rural population. In Bengal, too, it is said that for some three months in every year the capacity for labour of a large proportion of the inhabitants of rural districts, especially in western Bengal, is much impaired by attacks of malaria; and that malaria, in lowering the vitality of mothers, is one of the principal causes of the high rate of infant mortality from which Bengal suffers. Similar remarks are made regarding other provinces also.

Cholera is less widely distributed, and in most parts of India less constantly present than malaria. Bengal suffers more than any other province; the disease reappears year by year, and accounts on the average for rather more than 5 per cent of the total mortality. In the neighbouring province of Bihar and Orissa, the mortality rate from cholera is 2·2 per 1000, and the average mortality is nearly 90,000 annually (out of a population of 38 millions). Yet the disease is easily controllable, given a good

[1] "Royal Commission on Agriculture in India," Vol. 14. Appendix of the Report. Pp. vi+432+11 maps. (London: H.M. Stationery Office, 1928.)

water supply and the most ordinary sanitary precautions.

In Assam kala-azar is a special problem, and even takes precedence of malaria in importance; in the nineties of last century it took a terrible toll of life, leaving whole tracts deserted and uncultivated; the population of the district of Kamrup decreased during this period by 7 per cent, and that of Nowgong district by more than one-fourth. There is now an effective treatment; in 1925, 60,000 cases were treated, of which only 6365 died; twenty years ago, practically all the 60,000 would have been doomed to death.

Passing mention may be made of hookworm; in Madras, "in the wet districts, especially where rice cultivation is the main occupation, 80-100 per cent of the people are heavily infected with hookworm. This disease, though not immediately fatal, steadily undermines the physique of the population." In the eastern districts of the United Provinces, 86 per cent of the population are infected by hookworm. Plague we must pass over without comment.

The expectation of life in most provinces is about 21 years; in Madras, however, it rises to 26 years for males and 27½ for females; while in Burma, where the expectation is greatest, it is 31½ years for males and 32½ for females. A comparison with Great Britain may be made by saying that in the United Provinces the general death-rate is 2½ times as high as with us; this, of course, is largely due to the appalling infant mortality.

Along with the above facts must be considered the habits and conditions of life of the people. Of Madras it is said:

"Dwelling houses are badly constructed, devoid of light and ventilation. The houses of the very poor (and these unfortunately form the great majority) harbour both the human and the cattle population under the same roof; and cowdung and house refuse are accumulated in the close vicinity of the houses. In villages which have more than one source of water supply, no particular well or tank is reserved exclusively for drinking water, and pollution by washing, bathing, and by animal and human organic matter is universal. No system of drainage is in practice, with the result that pools form in every depression during the rainy season and stagnate in the hot weather. Of sanitary arrangements there are almost none, so that the soil in and around the village becomes polluted and all waterways are a positive danger. For medical assistance a villager may have to travel miles to the nearest dispensary, unless he is prepared to entrust himself to the administration of the 'quack.' Little wonder, then, that the deaths from preventable diseases reach appalling figures."

Most of this may be extended broadly to the whole of India; as most residents in India must have observed for themselves, the village pond serves for the village cattle to drink at and to wallow in, for young and old to bathe in, for washing the clothes of the village, for cleaning household vessels—and often for drinking also. In the general absence of any system of conservancy, the universal custom of the villagers is to go out in the early morning to relieve nature in the fields; in the larger villages and towns, the fields are not so easily reached.

Let me say, however, that it is unfair to bring a general charge of uncleanliness against the Indian villager. The brass cooking-pots of the poorest Punjabi will invariably be kept polished and shining; the courtyards of their houses often look fit to dine off; their ablutions are, of course, far more frequent than those of a European workman; it is simply that they do not understand cleanliness in quite the same sense as an educated European. So it is noted in the present volume that the Burman is by habit scrupulously clean, and the houses are as a rule also kept in a tidy and orderly manner, though here (as elsewhere) there is a tendency to carelessness in the village surroundings.

It is scarcely possible to outline the official measures which exist for dealing with the conditions above described. In all provinces alike there is the regular medical service, with in each district a chief hospital and a number of subsidiary hospitals, a civil surgeon, and a number of assistant surgeons; and in all provinces, too, there is now a department of public health, with a director and a number of subordinate officers. But the organisation of the public health service varies too much from province to province to allow of any short or general description. A few points may be selected for comment.

The inadequacy of the public health staff is acknowledged in several provinces. Thus in Burma, though the department is said to have been very substantially strengthened, it still appears to consist only of the director with two assistant directors, and in most districts the civil surgeon combines the functions of health officer with his own proper duties; recently, 16 sub-assistant surgeons (officers of a lower grade than the assistant surgeons, who have not gone through the medical course for a degree) have been placed at the disposal of the department, "but this number must be very much increased if any impression is to be made on the province." In the Central Provinces, there are no district health officers, and want of funds is complained of: "there is a Village Sanitation Act which is applied to a few villages, and funds are collected and spent on cleaning village sites, wells, etc. But no schemes of an extensive nature can be carried out." In Assam, where it is said that, next to kala-azar, malaria is probably the most potent enemy to human life, *in a few localities* (italics are mine) special antimalarial measures such as the clearance of jungles and undergrowths, the improvement of drainage, and the treating of sheets of water with kerosene, are being carried out by Government and by tea companies. In Bihar and Orissa "it is not easy to get district boards to realize their responsibilities, and the percentage of the board's expenditure on sanitation to their total income shows no tendency to increase."

A serious fact is the shortage and high price of quinine. This drug is generally available at the post offices, where it is sold at or below cost price. In Bengal it is reported that the total amount so

sold is very small—from 0·7 to 2 grains per individual per annum in different parts, while on the scale of the Italian consumption 8 to 20 times, and on that of the Greek, 30 to 90 times, as much should be consumed. It must be added, however, that distribution of quinine is also carried out by local authorities, antimalarial societies, and other agencies, and the total amount so distributed is now somewhat greater than that purchased through the post offices. In the United Provinces it is said that the chief requirement for combating malaria is a very much larger quantity of quinine, available at a very much lower price; "in 1921, the total stock available for the whole of India was 160,000 lbs.; double this quantity would be required for the United Provinces alone." In Madras "people are well aware of the value of quinine as a specific against this disease, and were it available in sufficient quantity, and at a price within the means of the people, it would be widely used. But in present conditions the cost of any scheme of general distribution is prohibitive." The actual price charged, in Assam for example, is 4½ annas (about 5*d.*) for 80 grains; the amount of quinine required, according to modern ideas, for the adequate treatment of even a single attack of one member of a family makes a large hole in a monthly income of, say, 20-30 rupees.

The official agencies are in many provinces doing a large amount of propaganda work, and are endeavouring to instil into the people the elements of hygiene, and the knowledge of the causation of disease and of simple measures for its prevention. In Assam much work is done by the kala-azar staff among the public and in the schools by means of lantern lectures and the distribution of bulletins, pamphlets, and pictorial posters. In the Punjab the village schoolmaster has been enlisted for propaganda. In the Central Provinces lectures are given by health publicity officers. The institution of 'Baby Weeks' and 'Health Weeks' appears to have become very generally popular throughout the country; in Madras, for example, the 'weeks' are run according to a model programme drawn up by the Director of Public Health; "the movement has appealed to the general populace in an extraordinary manner, substantial evidence of which is forthcoming in the increasing volume of funds raised by private subscription."

Unofficial agencies are also responsible for much good work in certain provinces. Foremost come the antimalarial societies of Bengal, which began in 1917, and comprised at the end of 1926 some 300 registered and 700 'live' unregistered societies. These seek to awaken the villagers to the necessity and the possibility of improving the health of their villages by their own efforts; they believe in practical work, and undertake to kerosene ditches and tanks, excavate drains and track out malaria 'carriers' for remedial treatment. In Madras in 1927 numerous lectures were delivered, posters and leaflets were distributed, and in some cases lanterns and slides were provided; presumably the greater part of this activity was due to private enterprise.

The series of provincial surveys which we have been considering has an informative purpose only, and is not intended either to emphasise the seriousness of the conditions or to put forward plans for dealing with them. Speaking in the most general terms, which alone is possible here, measures for alleviation must proceed on three lines.

(*a*) The continued prosecution of research in preventive medicine—a matter which is more especially the charge of the Government of India and provincial governments. There is no doubt that the governments on the whole, and especially the Government of India, recognise their duties in this respect; the maintenance of the Central Research Institute at Kasauli as well as other more recent institutions, the establishment of the School of Tropical Medicine in Calcutta, the appointment of the kala-azar inquiry, etc., are sufficient evidence of this.

(*b*) The provision of larger funds for more adequate staffing of the public health departments of the several provinces, and for the carrying out of pure water, drainage, and other health schemes. But sanitation must take its place along with administration, justice, police, education, public works, etc.; and therefore the possibility of such a provision depends in the first place on the economic prosperity of the country; all measures that increase this prosperity—the improvement of agriculture, the provision of more adequate communications, etc.—tend also to increase the possibility of doing more for the public health.

(*c*) Lastly, the most important factor in the improvement of the public health must be the education of the people. The Indian people have now, through the elected members of the provincial councils, as well as through the district boards and municipalities, a considerable voice in the disposal of provincial and local funds; expenditure on sanitation may not at once produce spectacular results—a gradual diminution of the death-rate, even if it is apprehended, is not a matter that makes an immediate appeal—and may involve violence to age-old customs; money is therefore not likely to be voted for sanitation until the people have been taught to appreciate the benefits that adequate sanitation bestows.

Much, very much, can also be done by the people, even apart from expenditure of public funds, if, as is happening in many places, they can be induced—by lectures, lantern demonstrations, exhibitions, lessons in school, posters, pamphlets—to take an interest in health matters and act for themselves. Possibly more potent, though acting more slowly, than all else would be the penetration of the masses of India by a rational system of general education, which would alter the habit of mind of the whole population, and lead them to substitute for the ideas of chance and fate that of cause and effect, to think backwards from the facts of disease and debility to the conditions of which they are the natural and necessary consequence, and to exchange the insouciant attitude of to-day for a reasonable activity directed to shaping their own welfare.

J. STEPHENSON.

News and Views.

PROF. GAETANA PONTE, the courageous Director of the Etna Observatory, describes the present eruption of Etna as being far more violent than the outbreaks of 1910, 1911, and 1923, all of which began to diminish in intensity after four or five days. The eruption began on Nov. 2 with a dense emission of ash-charged gas from the north-eastern slopes. Observation was difficult on account of mist, but it was noticed that lava began to flow copiously from three different places during that afternoon. The next morning lava broke through still more vigorously east of Mascali. since then almost every day has seen the appear- of a new fissure. The torrent of lava that de- led the Villonaccio valley quickly surrounded ali, and by Nov. 7 the little town was destroyed. e valley to the north the lava has crossed the railway line and reached the sea. A third flow in valley to the south seriously threatens Carrabba the larger town of Giarre. Here soldiers have blasting out a depression to conduct the lava to ea. On Nov. 8, Prof. Ponte flew over the great no and reported lava streams from several of entral craters. He predicted that the eruption d continue for at least another week. Since then ious stream has started from a fissure five miles -west of Mascali. Reports dated Nov. 12 stated there had been a decrease in activity and it was d that the halt of the lava flow would be definite. dy a rich agricultural district of fertile gardens orchards has been overwhelmed, and villages, es, roads, viaducts, cables, and water pipes have destroyed. There has been little loss of life g to efficient evacuation organisation, and already ees are employed in making a new road from towards Annunziata.

e secretariat of the Imperial Agricultural Research erence, which held its inaugural meeting a year has issued a second report detailing the action on the various recommendations which were made. It appears that little headway has yet made with the larger schemes proposed. The lishment of a chain of Empire research stations, reation of new imperial bureaux and correspond- centres, the scheme for large-scale irrigation rch, the training of biologists to meet the expected increased demand, are either shelved for the nt or are still under consideration. It is not to create new research stations until the of the Amani Institute is brought up to full gth. The governing bodies of the institutions hich it is recommended that clearing houses of mation should be attached have accepted the mendations in principle, and the British Treas- as accepted the principle of a contribution to- s the cost, but the other countries of the Empire yet to nominate representatives to a body which discuss questions of organisation, cost, and their ibutions. A discussion is proceeding with the ing Committee of Vice-Chancellors of Univer- and the Headmasters' Association is being on the steps to be taken to increase the output of biologists. Effect has been given, however, to several of the minor recommendations. It is disappointing to find that the manufacturing interests in Great Britain, which have been approached by the Ministry of Agriculture to provide scholarships for biological students and research workers, have not responded with any enthusiasm. It is equally disappointing to find such small indications of any enthusiasm of Overseas Governments of the Empire to undertake any financial responsibility for the encouragement of schemes of co-operative Empire research, although a year has elapsed since their formulation.

THE problem of water supply in great cities is one of growing importance, and not without anxiety for the future. Trustworthy statistics show that in the old type of house with water laid on but without hot water or bath, the daily consumption was seven gallons per head per day. In a modern cottage with bath and hot water, the daily consumption is fifteen gallons per head. With the view of adequate conservation and distribution of water supplies in the future, the Ministry of Health advises the appointment of regional water committees in Great Britain. A pamphlet under that title, issued by the Ministry, describes the work of such committees. They should be purely advisory and have no executive power. All the water boards and other water authorities whose interests are likely to be closely connected should be grouped in a committee with the view of discussing and reaching a common policy. Committees are advised to plan in detail for twenty years ahead, and in broad outline for fifty years. Periodical revision of projects will be necessary. Available supplies of water should be allocated to the best advantage of all areas in the region, and local supplies should not be overlooked in favour of upland sources. Reliable estimates of cost should always be obtained. It is hoped that these committees will be helpful in avoiding friction between rival claimants for water areas, and will reduce expense in the acquisition of satisfactory water supplies.

IN modern times mechanical advances produce their economic effect much more rapidly than was the case formerly. It took about forty years for a fairly complete network of railway systems to be established: twenty years for the roads of the country to be overrun and even congested by motor transport: and it will be a matter of a few years only from the full conquest of the air for air transport to become an important factor in our economic life. The railway companies have indicated that they are not to be caught napping a second time. The Air Council itself in its attempt to look ahead has now approached the local authorities with the view of enlisting their support to establish aerodromes in most of the towns. Inter-communication by air exists to-day between almost every large city on the Continent, particularly in Germany, and the encouragement to civil aviation afforded by municipal aerodromes is proving of great value. In a circular letter from the Air Ministry

to the local authorities in Great Britain, it is pointed out that in the absence of similar facilities, British industry cannot derive full advantage from air transport, and it is not possible for merchants to utilise aircraft, whether private or hired, for the speedy conveyance of material and documents either to Croydon, where they can connect with the cross Channel air service, or direct to their destinations abroad.

MUCH as the civil flying club movement has done to stimulate interest and foster enthusiasm in the air, progress is still hampered by lack of aerodromes and landing grounds. While provision for these facilities by the State must be confined to terminal points on 'trunk' routes, the establishment of a network of aerodromes, it is asserted, must devolve on the local authorities. Every town of any importance will sooner or later find it as essential to possess aerodromes as to possess stations, roads, and other facilities of transport. The Air Ministry is to be congratulated on this progressive step to foster a necessary development. The sooner local authorities become alive to the truth of the Air Ministry's contentions, the easier will it be for them to purchase land suitable for this purpose, before speculation renders the price prohibitive.

SEVERAL members of the staff of the Royal Botanic Gardens, Kew, have recently been studying problems of economic botany overseas. Mr. H. C. Sampson has just returned to Kew from his mission to British Honduras, which he paid at the request of the Governor of the Colony, with the approval of the Colonial Office and the Empire Marketing Board. His object was to study agricultural conditions in the colony and to offer advice as to future developments. The assistant director at Kew, Dr. T. F. Chipp, has just left to pay a visit to Cyprus and to the Sudan, at the request of the respective governments, to study botanical and agricultural problems, and he will be absent for about three months. This visit is being undertaken in connexion with the Empire Marketing Board's grant to Kew. A third visit, which should result in the acquisition of much valuable material both living and dried for the Herbarium, is being paid by Mr. J. Hutchinson. This also has been made possible by the Empire Marketing Board's grant to Kew. Mr. Hutchinson is making a careful study of the South African flora in conjunction with the South African botanists, which should be of great value to botanists in both places, as Kew possesses the old type specimens on which the "Flora Capensis" was written, but British botanists who have had to do with the flora have not seen the plants growing in their own home; while, on the other hand, very few of the botanists at the Cape have had the opportunity of seeing the types at Kew. The Director of the Royal Botanic Gardens, Dr. A. W. Hill, has just returned from delivering a short course of lectures at the Charles University, Prague, on the invitation of the University.

SIR GEORGE H. KENRICK has recently presented to the Natural History Department of the Birmingham Museum and Art Gallery his entire library of works on entomology. The collections of insects in the Museum are of great importance and widely known, but no books relating to this particular branch of natural science have hitherto been available for consultation in the department. The gift comprises about five hundred volumes, including several early treatises, almost unobtainable nowadays, dealing with Lepidoptera found in every part of the world and containing hundreds of exquisite coloured plates. The collection also includes a number of popular books helpful to the beginner, as well as extensive series of reports and proceedings issued by various learned societies. A catalogue of the library is being prepared, and it is anticipated that the books will shortly be accessible, under proper conditions, to persons specially interested. For many years Sir George Kenrick has evinced keen interest in the progress of the Birmingham Natural History Museum. So early as the year 1912 he presented a collection of Midland Coleoptera, collected by the late Mr. W. G. Blatch. In 1915 he loaned, and afterwards presented, four handsome cases illustrating the evolution of the Lepidoptera, and so recently as 1927 he gave to the Museum his noted collection of foreign butterflies and moths, amounting to many thousands of specimens and arranged in eight mahogany cabinets. This collection, unfortunately, is not yet housed in the Museum owing to lack of adequate accommodation.

THE International Society of Experimental Phonetics, founded in connexion with the International Congress of Linguistics at the Hague in April of this year, has for its objects the promotion of research in phonetics. It is providing for the production of accurate apparatus for recording speech and measuring and analysing the speech curves. Arrangements for the publication of the work of its members are being made in England, Germany, and America. Its field of activity includes not only the linguistic side but also the physical study of speech with its relations to telephony, the psychology of speech, speech neurology, etc. Its governing board is at present constituted as follows: *President*, Prof. E. W. Scripture, Strudelhofgasse 4, Vienna, Austria; *Vice-President*, Dr. E. A. Meyer, Stockholm; *Honorary Members*, Prof. A. Meillet, Paris, and Prof. H. Zwaardemaker, Utrecht; *Regional Representatives*, Dr. A. Abas, Amsterdam; Dr. A. Äimä, Helsingfors; Prof. J. L. Barker, Salt Lake City; Prof. T. Benni, Warsaw; Prof. V. A. Bogoroditzskij, Kasan; Dr. T. Dunajewski, Charkow; Prof. M. Grammont, Montpellier; Prof. C. A. Grandgent, Cambridge, Mass.; Prof. A. Gregoire, Liège; Prof. L. Grootaers, Louvain; Prof. P. Menzerath, Bonn; Prof. M. Metfessel, Iowa City; Mr. Marshall Montgomery, Oxford; Prof. I. Popovici, Cluij; Prof. A. Rosetti, Bucharest; Prof. L. Ščerba, Leningrad; Prof. E. W. Selmer, Oslo; Prof. T. Navarro Tomás, Madrid. The membership fee is 5s. (8¼ Austrian Schillinge). Applications for membership are received by the president or any regional representative.

A PAPER on "Field Archæology as a Profession," by Sir Frederic Kenyon, in the November issue of the *Nineteenth Century and After*, is in effect a timely

survey of present conditions in archæological research which incidentally raises a number of questions of wider bearing than its title suggests. To a certain type of man, or woman, as Sir Frederic points out, the life of a field archæologist has many attractions to offer; but it cannot be said that the supply of really suitable candidates is adequate. Still more is this true in anthropology, where the need of field work is as great, if not greater, but the opportunities are more limited than they are in archæology. The number of students in our universities who take up social anthropology, apart from government officials, either prospective, on leave, or specially seconded, and missionaries, is disappointingly small. Academic authorities, when confronted with the dearth of suitable men in both branches of investigation, are, however, not without justification for their reply that, given the posts suitable, men will be found and trained to fill them. So far as archæology is concerned, Sir Frederic Kenyon is able to point to the fields of investigation which have been opened up or extended since the War, some partly or entirely under our own jurisdiction, such as Iraq, Palestine, Cyprus, Honduras, India, and so on; others which are available through co-operation with other countries, such as Greece. Sir Frederic points out that the great excavators who have made modern archæological history, have attained the rank of veterans and a younger generation must take their place. Even so, in present conditions, the number which can be absorbed is limited, not because the field is restricted, but because the funds required to carry out the work on a scale which would make archæology really a profession which would attract are not forthcoming. The same argument applies even more strongly to social anthropology and ethnology. In all branches of the study of man a fund which will provide an assured basis for the systematic prosecution of research in the field is the first and most urgent requisite.

AT a joint meeting of the Scottish sections of the Society of Chemical Industry, Institute of Chemistry, and Society of Dyers and Colourists, held in Glasgow on Oct. 19, Dr. H. H. Hodgson, head of the Chemical Department, Technical College, Huddersfield, surveyed recent utterances at public conferences during 1928 from the points of view of the chemist and teacher. 'Science and Craftsmanship," by Sir William Bragg, received primary attention. In consequence of the revolution in industry now in progress and the ever-increasing dependence of industry on process and ever-diminishing reliance on manual skill, the importance of humanistic non-vocational studies in our national scheme of education was stressed, since in a democratic age when great issues are decided by a majority vote the necessity for all sections of the population to meet on common ground somewhere becomes self-evident. The work of research associations justifies Sir William Bragg's opinion that "much of our hope for the future is built upon their work." The position of the chemist in industry was considered and a rapid survey made of large-scale operations which have little or no laboratory equivalent; above all, the importance of a knowledge of costing was emphasised. Lord Melchett's valuable presidential address to the Association of Technical Associations was recommended for reading as a great stimulant for the science teacher; it is difficult to overrate the national importance of contentment in employment brought about by a proper realisation of the underlying interest in all scientific operations. Teachers of experimental science, however, should have research experience, only such men being capable of inspiring pupils both by precept and example.

THE Institute of Physics has arranged a scheme by which any corporate member who wishes to borrow an instrument for research or demonstration purposes may do so from one of the 37 firms of instrument makers who are participating in the scheme. The charge will be £1, 1*s*., plus 10 per cent of the price of the instrument for the first fortnight, and 5 per cent for each subsequent week. If the loan is continued for 20 weeks, the instrument becomes the borrower's own. The borrower pays carriage both ways, and is responsible for any damage to the instrument in transit or in use, fair wear and tear excepted. Applications for loans should be made to the Institute. The Institute has also announced a further privilege of membership by which, commencing in January 1929, fellows will receive the *Journal of Scientific Instruments* free of charge, and associates receive it at a small charge. The *Journal* is produced by the Institute with the co-operation of the National Physical Laboratory. It was established in 1923, and is now in its fifth volume. The consistently high standard of contributions which has been maintained is reflected in the increasing circulation and improved position which has enabled this scheme of distribution to be undertaken.

A MOVEMENT is on foot for the creation of a Twickenham Museum, to be housed in York House, and to be under the ægis of the local town council. As reported in the *Thames Valley Times* of Oct. 17, a public meeting agreed with enthusiasm to the formation of a museum, and a committee, of which the Mayor-elect, Councillor C. Carus Wilson, was appointed chairman, was elected. The speeches made at the meeting suggest that somewhat vague ideas of the functions of a local museum were entertained by some of the audience, and the statement that amongst the gifts accepted were "spear-heads many feet long" suggests that this museum at its outset may be in danger of encouraging the collection of the world-wide odds-and-ends which have proved the bane of so many local museums. The formation of a local committee, however, should now enable a definite policy of development to be formulated, and no better guide to such a policy could be found than Sir Henry Miers' report to the Carnegie United Kingdom Trustees.

THE University of Liverpool continues to be a growing and active centre of tidal research and computation through the work of Drs. Proudman and Doodson, Director and Secretary of the Tidal Institute (University of Liverpool. Tidal Institute, Ninth Annual Report, 1928). Besides the publication of theoretical researches, analyses of tidal observations for seven

ports have been made, for the Admiralty, Australia, and the Crown Agents for the Colonies; predictions have been prepared for fifty-one ports. A special feature of the year's work was the investigation of the circumstances that resulted in the disastrous Thames floods of Jan. 6–7, 1928. Dr. Doodson made a detailed study of the variations of sea-level all round the North Sea for intervals including four great storms, and it is stated that some remarkable sequences were revealed. He has also further developed the methods of analysing tidal observations, and a short account of some of his methods is included in the "Instructions for Analysing Tidal Observations," published as a small pamphlet by the Hydrographic Department of the Admiralty (price 9*d*. net).

M. HENRI BERGSON, the distinguished French philosopher whose name is associated with the theory of creative evolution, has been awarded the Nobel prize for literature for 1927. The Nobel prizes for chemistry for 1927 and 1928 have been awarded to Prof. H. Wieland of Munich, for his work on gall acids, and to Prof. A. Windaus of Göttingen, for his work on the stearines and their relation to vitamins, respectively.

DR. H. DESLANDRES, director of the Paris Observatories at Meudon, has been elected an honorary member of the American Astronomical Society. Only one such election annually is permitted by the constitution of the Society, and there are only seven other living honorary members.

THE following have been elected officers for the session 1928–29 of the Philosophical Society of the University of Durham: *President*, Sir Charles A. Parsons; *Vice-Presidents*, Dr. G. R. Clemo, Mr. Wilfred Hall, Mr. H. J. Hutchens, Dr. J. Irvine Masson, Sir Theodore Morison, Dr. John Morrow; *Hon. General Secretary*, Dr. D. A. Allan; *Hon. Treasurer*, Mr. J. W. Bullerwell.

THE annual general meeting of the Mineralogical Society was held on Nov. 6, and the following officers were elected: *President*, Dr. G. T. Prior; *Vice-Presidents*, Sir J. S. Flett and Dr. J. W. Evans; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith (Natural History Museum, South Kensington, S.W.7); *Foreign Secretary*, Dr. J. W. Evans; *Editor*, Dr. L. J. Spencer.

AT the annual general meeting of the Cambridge Philosophical Society, held on Oct. 29, the following were elected officers of the Society for the ensuing session: *President*, Mr. G. U. Yule; *Vice-Presidents*, Prof. G. I. Taylor, Dr. H. Lamb, Prof. S. J. Hickson; *Treasurer*, Mr. F. A. Potts; *Secretaries*, Mr. F. P. White, Mr. F. T. Brooks, Dr. D. R. Hartree; *New Members of the Council*, Prof. A. Hutchinson, Mr. R. H. Fowler, Mr. J. T. Saunders, Mr. S. W. P. Steen.

THE following officers and new members of council of the London Mathematical Society were elected at the annual general meeting held on Nov. 8: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Mr. R. H. Fowler, Prof. E. H. Neville, Mr. E. C. Titchmarsh; *Treasurer*, Dr. A. E. Western; *Librarian*, Prof. H. Hilton; *Secretaries*, Prof. G. N. Watson, Mr. F. P. White; *New Members of Council*, Prof. O. Veblen, Mr. T. L. Wren.

"THE Culture Value of Natural History" is the title of the fourth annual Norman Lockyer Lecture, to be given under the auspices of the British Science Guild by Prof. J. Arthur Thomson, Regius professor of natural history in the University of Aberdeen, on Wednesday, Nov. 28, at 4.30 P.M. in the Goldsmiths' Hall, Foster Lane, E.C.2 (by permission of the Goldsmiths' Company). A few tickets for the lecture are still available and are obtainable on application to the Secretary, British Science Guild, 6 John Street, Adelphi, London, W.C.2.

BY the exploitation of her own resources and the skilful adaptation of Western ideas, Japan has, during the past half-century, left medievalism behind and become a world power of first-class importance. The extent of her development of research in the physical sciences alone was indicated in an article which appeared in our issue of Mar. 12, 1927, p. 407. The recent enthronement at Kyoto of the young Emperor of Japan has therefore been made the occasion for many tributes and congratulations, both official and unofficial, with which we are sure that scientific workers in particular will wish to be associated. In this connexion Sir Robert Hadfield, who is himself a member of the Japanese Order of the Sacred Treasure, has contributed an appreciative message to the *Japan Advertiser*, in which he refers to his own visit to Japan and to his meetings with Japanese leaders, including the present Emperor before his accession to the throne, when on visits to Great Britain.

A MONTHLY magazine for young people, entitled *Friendship* (price 6*d*.), is published at Ramhurst Manor, Tonbridge. It aims at fostering friendship between the youth of all nations by means of actual travel and a better understanding of the characteristics of various peoples. Each number is devoted to one or more countries in pictures and articles descriptive of national life, traditions, customs, and scenery. The October number treats of Norway, Sweden, and Denmark. The articles are short and interesting, and well illustrated by wood blocks. There is also a large pictorial map of Scandinavia. This kind of map is entertaining and likely to interest children, even if it lacks something in accuracy. There are other features of interest in the magazine, and the whole has a strong savour of the sea.

THE September issue (No. 15) of *Watson's Microscope Record* contains matter that will be of interest to most microscopists. Beginners will find help in Mr. Merlin's article, which deals with the choice of instrument and the importance of tube-length, or if they are taking up photomicrography, in the instructions given for developing the negative. The Rev. Dingley Fuge discusses the structure of a common diatom, Mr. Brown tells us how properly to display the blow-fly's tongue, and Mr. Gray gives some useful hints on mounting-media and on mounting insect parts. In lighter vein is "A Message from Mars"—a fable, and Mr. Offord's

reminiscences of fifty years ago, including his first attendance at the Quekett Club with Huxley as president. 'Notes and Queries' and descriptions of apparatus and instruments complete an interesting number, which may be obtained from Messrs. Watson and Sons, 313 High Holborn, London, W.C.1.

MESSRS. Bowes and Bowes, Cambridge, have just circulated a useful catalogue (No. 444) of second-hand works—1000 in number—ranging over the following branches of science: Scientific biography and travel; agriculture, with gardening and forestry; anthropology and ethnology; chemistry and physics; geology and mineralogy; biology (general), including microscopy; botany; zoology (general); marine and fresh water zoology; entomology; ornithology, and miscellaneous science. The catalogue can be had upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An experimental biologist at the Middlesex Hospital Medical School, for radiological research bearing on the therapy of malignant disease—The Dean of the Medical School, Middlesex Hospital, W.1 (Nov. 26). A lecturer in civil engineering at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (Nov. 27). A professor of dental surgery and pathology and superintendent of studies in the Dental School, Cairo—the Dean of the Faculty of Medicine, Egyptian University, Cairo (Nov. 28). A special librarian for the Institute of Metals—The Secretary, Institute of Metals, 13 Members' Mansions, Victoria Street, S.W.1 (Nov. 29). A professor of materia medica and therapeutics at the Royal Veterinary College—The Secretary, Royal Veterinary College, Camden Town, N.W.1 (Nov. 30). A lecturer in biology and chemistry in the chemistry and dyeing department of the Leicester College of Technology—The Registrar, College of Technology, Leicester (Nov. 30). A lecturer in applied mathematics in the Faculty of Science of the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (Dec. 1). A lecturer in physiology in the University of Birmingham—The Secretary, The University, Birmingham (Dec. 3). A physiological botanist for research work on cotton to be carried out at Coimbatore under the Development Department of the Government of Madras—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 14). A secretary of the Education Committee of the League of Nations Union—The Secretary, League of Nations Union, 15 Grosvenor Crescent, S.W.1. An assistant to the surveyor of the School of Agriculture Estate Management Branch, University of Cambridge—The Estate Management Branch, School of Agriculture, Cambridge. A lecturer in agricultural biology at the Seale Hayne Agricultural College—The Principal, Seale Hayne Agricultural College, Seale Hayne, Newton Abbot.

Our Astronomical Column.

A RECENT SUNSPOT.—A large group, typically 'bipolar' in appearance, has recently been under observation. The group was conspicuous on account of the size and regularity of the leader spot, which exceeded 700 millionths of the sun's hemisphere. There was a cluster of spots forming the other extremity of the group 15° of longitude behind the big spot. On Nov. 4, when the group was near the east limb, Mr. Newbegin noticed a bright reversal of the *C*-line of hydrogen in the preceding part of the umbra of the leader spot, and he also detected dark filaments between it and the cluster of spots in the rear. These latter spots seemed to be associated with a metallic prominence seen at the east limb on Nov. 3. No associated magnetic disturbance was recorded about the time of central meridian passage of the group on Nov. 9, further particulars of which are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
10	Nov. 2-15	Nov. 9·4	16° S.	1/1100 of hemisphere.

THE ECLIPSE OF MAY 9, 1929.—*Astr. Nach.*, No. 5589, contains an article by Mr. F. J. M. Stratton on this eclipse, which is the third in the present century in which Sumatra enjoys totality; the others were in 1901 and 1926. On this occasion Siam and the Philippine Islands are also available as stations. The Greenwich and Cambridge party will occupy Alor Sta in Kedah, and Pattani in Siam. The investigation of the Einstein displacement of stars near the sun will be made at both stations; the Greenwich astrographic equatorial will be mounted at Pattani and a cœlostat at Alor Sta. The spectrum of the chromosphere and corona will be studied, also polarisation and rotation of the corona.

There will be numerous other parties. German expeditions will be sent from Potsdam, Kiel, Hamburg, and Göttingen. Italian and French expeditions, and two or three American ones, will also be observing the eclipse. The line of stations to be occupied is so long that there is very good prospect that at least some of the parties will have favourable weather conditions.

THE INDEBTEDNESS OF GREEK ASTRONOMY TO BABYLON.—The *Observatory* for October publishes a lecture on this subject, delivered last February by Dr. J. K. Fotheringham. It has been made clear in the present century that much of the knowledge of the motion of the sun and moon that had been supposed to have been deduced by the Greeks from their own observations was derived from Babylonian astronomers, in particular Naburiannu and Kidinnu. To them was due the determination of the length of the synodic month which Ptolemy attributed to Hipparchus. One important discovery still seems to be Hipparchus's own, that is, the precession of the equinoxes. The Babylonians seem to have noticed some anomalies in longitude, but not to have traced them to a motion of the equinox. Dr. Fotheringham is able to fix the year 383 B.C. as that of the adoption of some of Kidinnu's values, and the beginning of the use of the 19-year lunar cycle. Naburiannu's date is about 500 B.C. The extraordinary fact is brought out that Kidinnu's value for the motion of the sun from the node was nearer the truth than that used by Oppolzer in his Canon of Eclipses more than two thousand years later. Kidinnu's value was based on the Babylonian observations of eclipses for the preceding 360 years. His good result is a testimony to the quality of these observations.

Research Items.

American Indian Music.—Miss Frances Densmore, the well-known student of the music of the American Indian, and author of a number of monographs on the music of specific tribes, has published in the *Journal of the Washington Academy of Sciences*, Vol. 18, No. 14, a study of the general characteristics of Indian music based upon more than 1700 songs which she has collected since she began work in 1893. With the American Indian, music is not an art in our sense of the term, but primarily a means by which he believes that he can put himself in communication with the mysterious forces of the earth, sea, and air, to which he looks with awe and reverence in his daily life. It was therefore used primarily in the working of magic and the treatment of the sick. Nor was it based originally on the tones produced by an instrument. Only the correct version of a song is recognised by the Indian. It must be repeated absolutely accurately. A repetition has been found not to vary in tempo, pitch, and note values after an interval of two years. The analysed songs do not suggest a resemblance to the songs of Asiatic or European countries, though the Indians themselves recognise two classes of songs. The second class shows what appears to be Spanish, Roman Catholic, or Russian Church influence. Collective analysis shows a perception of simple ratios of vibration, but these tones are frequently used in what may be termed an interval-formation of melody, which does not suggest a keynote, and has no counterpart in our musical usage.

Fire-Making.—Mr. Walter Hough has written a description, very fully illustrated, of the fire-making apparatus in the United States National Museum, which is published in Vol. 73, Art. 14 of the *Proceedings*. These appliances, that is, those of primitive type and leaving aside lens, mirror, matches, and other modern methods, fall into five main categories, each with well-marked distribution. The first is on wood by reciprocating motion. Of these, the two-part method, in which fire is produced by friction of two pieces of wood of varying form, has the widest distribution, being found among the Indians of North, Central, and South America, Australians, Japanese, Africans, etc. The four-part apparatus, mouth drill and two-hand drill, is found among the Eskimo, some Indians, in Siberia, among Hindus, and among the Dyaks. The compound weighted drill occurs among the Chuchis and the Iroquois. The sawing motion, the second main division, in which knife and thong are used, occurs among the Malays and Burmese. The third division, still on wood, is that of the ploughing or planing motion, which is found among the Polynesians and some of the Australian tribes. The fourth method, of percussion, is used with minerals, and is that to which the flint and steel belong. Pyrites, or stones containing iron, and flint, are in use among the Eskimo and Indians of the north of North America of the Algonkian and Athapascan stocks, while flint or other hard substance is used to strike sparks from the bamboo by the Malay. Pictorial data in the manuscripts show that the ancient Mexicans used the simple fire drill, and its use is still continued among the uncivilised tribes of the mountains in Mexico. The simplest and rudest fire-making appliance in the collection is that which comes from Costa Rica, the hearth being a rude billet or charred block of wood and the drill a branch rudely trimmed with a knife. It is said that the Apache is the most skilled fire-maker in the world. Many tribes can produce fire in less than a minute. The Apache can make it with a fire-stick in less than eight seconds.

Human Teeth as Race Indicators.—The arrangement of the cusps accompanied by a definite system of grooves in the lower molar teeth of man appear to have distinct evolutionary significance. The fundamental pattern is markedly primitive and has been termed by W. K. Gregory the "Dryopithecus pattern." It is now shown by Milo Hellmann (*Proc. Amer. Philos. Soc.*, vol. 67, No. 2) that in man the pattern is undergoing a gradual and progressive change, which can be recognised by certain well-defined stages, marked by modification in the furrows or by a reduction in the number of the main cusps, or by both. The most advanced stage in this series consists of four cusps and a cruciform groove in place of the five cusps and Y-shaped groove of the most primitive pattern. This highest stage of reduction is characteristic of modern white races, and it would appear that American children are more advanced than ancient and modern Europeans. The most primitive stage is retained by the natives of West Africa, and intermediate forms are possessed by the Mongols. The paper is in the nature of a general survey, and more detailed accounts are promised on the completion of further investigations.

Sympathetic Nervous System of Lepidosiren.—Miss P. M. Jenkin (*Proc. R. Soc. Edin.*, vol. 48, pt. 1, No. 7; 1928) has made an investigation of the sympathetic nervous system in *Lepidosiren*, hitherto undescribed, and finds it to consist of a single delicate main cord of nervous tissue running each side of the dorsal aorta, and containing ganglion cells, either singly or in groups, but in no case forming visible swellings of the cord. At the anterior end the cords join a branch of the first spinal nerve, but do not reach the vagus ganglion. Rami communicantes are present in the trunk region, one from each spinal nerve, but are absent from the caudal region. Medullated nerve fibres are absent, and there is no collateral system. Comparing the sympathetic system in *Lepidosiren* with that of other lower vertebrates, the author concludes that it most nearly resembles the Salamandrine type, and is, in fact, intermediate between that type and the Ichthyodian type as described by Anderson. It is simpler than the latter type in lacking both cranial and collateral portions and a prevertebral plexus. The sympathetic system of *Lepidosiren* is extremely delicate, and associated, as is usual in such cases, with a strongly developed vagus.

The Contractile Vacuole.—The attention of physiologists and biologists is directed to the current issue of *Biological Reviews* (vol. 3, No. 4, Oct. 1928), which contains admirable summaries of the present state of knowledge on tissue culture from the point of view of general physiology, by Mr. E. N. Willmer, on anaerobic life in animals, by Dr. W. K. Slater, and on the contractile vacuole—its structure, behaviour, and function—by Prof. Francis E. Lloyd. It is impossible to summarise these reviews, but a few points from the last may be noted here. Prof. Lloyd remarks that in all known cases the contractile vacuole is correlated with either the absence or non-rigidity of the cell wall or with displacement of the protoplast therefrom. He has recently been examining marine protozoa and has found a number of species in which the contractile vacuole occurs, though it is usually stated that the contractile vacuole is generally absent in marine protozoa. During the very early phase of systole of the contractile vacuole of *Paramecium* there is a reflux of fluid from the vacuole into the radial canals.

and systole of the canals is synchronous with the early period of diastole of the contractile vacuole." Prof. Lloyd has carefully studied the contractile vacuole in the gametes of *Spirogyra*, and is convinced that vacuoles may be repeatedly formed in the same position exactly and burst repeatedly in the same point on the surface. The function of the contractile vacuoles of *Spirogyra* is unequivocally to rid the gametes of water, leading to their condensation to the volume of the definitive zygote. While it would be tempting to generalise that the function of the contractile vacuoles is to get rid of water in those forms which have not the support of a membrane of sufficient rigidity to resist the osmotic pressure of the protoplast, the author thinks this might be going too far.

EXPLORATORY VOYAGES FOR HAKE.—The Fleetwood exploratory voyages for hake (C. F. Hickling, *Jour. du Conseil Perm. Int. pour l'Exploration de la Mer*, vol. 3, No. 1, April 1928) were made in an endeavour to extend the commercial trawling grounds, particularly into deeper water. The Faroe-Shetland channel proved exceedingly poor in all kinds of fish, but farther south, on the western slope of the Wyville Thomson Ridge, good catches were obtained. Mr. Hickling made observations on the numbers of hake caught per hour, and showed that the optimum depth in the areas investigated was between 260 and 300 fathoms; down to 380 fathoms a fair quantity was obtained, after which the fish disappeared. Data are also given of the temperatures in which the hauls were taken, but it is not clear whether the optimum temperature, which was different in different regions, is merely a reflection of the optimum depth or not. Attention is directed to the importance of the blue whiting (*Gadus Poutassou*) as hake food on the northwestern fishing grounds in 1927; possibly the high catches on the Wyville Thomson Ridge were due to a transitory abundance of this fish.

RESEARCHES ON THE HOLOTHURIAN *CAUDINA*.—In his paper "On the Changes occurring with Advancing Age in the Calcareous Deposits of *Caudina chilensis* (J. Müller)" (*Science Reports*, Tôhoku Imperial University, Fourth Series (Biology), Sendai, Japan, vol. 3, No. 3, fasc. 2, May 1928) Mr. Sanji Hôza shows that there is a gradual change in the spicules with the growth of the body. He divides the individuals into four stages, each stage showing an advance in the organisation of the calcareous deposits. Thus Stage 1 consists of very young animals having these deposits only in the integument, anal projections, calcareous ring and madreporic body, Stage 2 having them also in the membrane investing the inner base of the tentacle crown, Stage 3 in addition having them in the radial longitudinal muscles of the body wall and in the stone canal, whilst Stage 4 has them also in the circular muscles of the body wall. The size of the calcareous ring is important in determination of age, as it is apparently strictly proportional to the growth of the animal. Corresponding with these stages there may be changes in form, size, and quantity of the spicules. The main spicules are rings enclosing a cross on the outer surface and a square on the inner, the number increasing with age and each spicule becoming more irregular in shape. The calcareous ring also changes considerably in shape and size. Mr. Lieh Tao, in "Preliminary Observations on the Chemical Effects upon the Lengthening of Caudina Muscle," dealing with the same organism in continuation of his previous work (Part 2, 1927, of this Report), studies the behaviour of the ventral longitudinal muscle in various solutions, these smooth muscles being apparently more sensitive to the effect of salts than are striated muscle and the smooth muscles of vertebrates.

A DISEASE OF THE BASKET WILLOW.—R. M. Na trass describes a disease of the basket willow in t *Transactions of the British Mycological Society*, vol. parts 3 and 4, Oct. 1928. The causal organism thought to be *Physalospora Miyabeana* Fukushi. T fungus produces a 'black canker' upon the rods, b has hitherto been regarded as a wound parasite onl but Nattrass shows that it may penetrate the cutic of the young leaf or stem and thus produce considerab damage upon certain varieties of willow under cultiv tion in the west of England. The primary attacks a confined to the young shoots, but when young rods, s or eight inches long, are attacked, the fungus may wo down the entire length of the shoot and enter t parent stool. Spraying with Bordeaux mixture suggested as a method of control, and field trials a in progress to test the suggestion.

METHODS OF TRANSPORTING TREES AND SHRUBS.- Jas. A. Neilson, of the Department of Agriculture, Po Hope, Ontario, Canada, has a note in the *Gardene Chronicle* for Oct. 27, which suggests the trial of a ne method where scions, after removal from the pare plant, have to be kept some time and possibly tra shipped, before they can be grafted upon the stoc Such scions are very apt to dry out, and their mainte ance in moist sawdust during long periods has ma disadvantages. Neilson has tried instead the effect coating the shoots with hot paraffin wax. Waln scions thus treated were transported from Canada England; whilst fruit and nut trees, after similar trea ment, were sent from Poland to Canada and afterwar held in storage for some time before grafting. T results seem to have been very successful, and Neils also suggests this method for the stems and twigs woody shrubs and trees that have to be held in stora for some time before planting. The wax is apparent applied with a brush whilst hot. The treatment therefore a simple and inexpensive one, and commen itself as antiseptic in tendency. It should at least b worth a more extensive trial.

IRRIGATION SURVEYS IN INDIA.—The practice rectangulation in irrigation surveys is widely followe in the Punjab and elsewhere. The main rectangles a divided into small rectangles, and levels are shown all the corners. On such a network superimposed the topographical map it is possible to lay out wi accuracy a system of watercourses and canals. A account of the methods of rectangulation and a di cussion of the value of the system is published by t Survey of India in *Professional Paper No. 21* (Irrig tion and Settlement Surveys, 1926, price 2*s.* 6*d.*). T corners of main rectangles are usually fixed by traver ing, since the closing of the traverse is an immedia check on the accuracy of the work. In very ope ground or low hills, triangulation is sometimes use The rectangles are marked on the ground by corn stones. The main rectangles are made as long possible and generally are about 3 miles by 2 mile They must be capable of subdivision into rectangles the dimensions required by the Revenue Departme which would appear to be 25 acres, with sides of 11 yd. and 990 yd. The paper includes several sheets rectangulation survey.

TECTONICS OF THE GREAT RIFT VALLEY.—As result of travel in Uganda and Tanganyika a detailed geological work in Kenya, Dr. E. Parso has reached some definite conclusions with rega to the origin of the Great Rift Valley, which, wi the evidence on which they are based, are record in the *Trans. Geol. Soc. S. Africa*, pp. 63-96; 192 He shows that the earth movements that ha affected the strata of the coastal region of Ken

were a result of compressional stresses rather than tensional, that is to say, that they were due to crustal pressures such as in other regions have resulted in the formation of folded mountain structures. The latter, however, have been produced in heavily sedimented areas containing long stretches of relatively unconsolidated deposits. In Africa these were not present, but, on the contrary, the region consisted largely of crystalline and thoroughly consolidated rocks, which had long underlain a stable land area. Consequently, according to Dr. Parsons, instead of folding, the rocks fractured along reversed faults which, with the subsequent vulcanicity and denudation, have given rise to the unique land-forms seen along the Rift Valleys. Several advantages are claimed for this view, but no explanation is afforded of the highly characteristic double-sided character of most of the rifts; nor is the hypothesis brought into harmony with the implications of isostasy.

THE ELECTRIC MICROMETER.—The increasing use of very large steam turbines has made it necessary to improve the methods of testing their 'balance' in order to avoid the large unbalanced forces which are sometimes called into play when they are running. When there is a good balance, the radial motion of the rotating part of the steam turbine is only at the most a few thousandths of an inch. In order to test the running of the machines, the General Electric Company of America makes an electric micrometer which has been successfully used to measure the vibrations of rotating shafts when the amplitude of the vibration is as small as the ten-thousandth of an inch. A description of the instrument and of some of its applications is given in the *General Electric Review* for October. A special oscillograph is used, the vibrations of which depend on the amplitude of an air-gap which varies with the vibrations that have to be measured. When obtaining a measure of the mechanical vibrations, the air-gap is calibrated to thousandths of an inch, and when recording transient pressures it reads in pounds per square inch. Variations of the pressure of the water in a 24,000 kilowatt water turbine are shown. Thirty electrical periods correspond to one revolution of the turbine runner. By plotting curves from the oscillograms it was found that the pressure variations were greater when the load was 15,000 kilowatts than at full load. When testing a steam turbine rotor it was noticed that the shaft amplitudes were appreciable for one and a half hours after the rotor had started. This is attributed to the unequal heating of parts of the rotor during the early stage of the running. Three consecutive figures of revolution showing the displacements are given of a point on the axis of the turbine shaft when making 1800 revolutions per minute. The electric micrometer has also been applied usefully to get the indicator curves of high speed.

PRODUCTION OF CARBON DIOXIDE BY FERMENTATION.—Although at the present time certain breweries collect carbon dioxide evolved during fermentation, there are certain strong objections to what at first sight appears to be a profitable undertaking. In the first place, the gas differs from that produced by other methods, in that it contains as impurities traces of esters and of higher alcohols, a disadvantage which, however, loses much of its weight if the gas is to be used for carbonation purposes. A more serious objection is the fact that the collection of all the carbon dioxide evolved in brewery fermentations would result in overproduction and so render the procedure unprofitable. F. Stockhausen and F. Windisch (*Wochenschrift für Brauerei*, 45, 277 et seq.; 1928) have recently pointed out that the increasing technical uses for the gas, notably in the frozen state as a substitute for ice, may provide the necessary demand. Further, they dispel the most important objection of all, based probably on a misinterpretation of the experiments of Prandtl and of Foth about forty years ago, that the effect of the pressure necessarily produced when the gas is collected in closed vessels over the fermenting vats is harmful to the yeast. For pressures of from 70 mm. of water to 1 atmosphere, they found that the rate of fermentation and the growth of the yeast are not arrested, but merely retarded, and that after about eight days the fermentation approaches normal conditions and finally yields a satisfactory beer. The yeast from the pressure fermentations was, moreover, healthier, had greater fermentative powers, and was less subject to degeneration than that normally produced. These latter results are striking from the purely biological point of view, and if they are confirmed on the large scale they should be of great practical importance.

CARBON MONOXIDE COMBUSTION.—At the Royal Society meeting on Nov. 1, Prof. W. A. Bone and his associates communicated the results of researches on the combustion of carbon monoxide, oxygen, and air mixtures at high pressures. With D. T. A. Townsend and G. A. Scott it was shown that the addition of hydrogen markedly accelerates the combustion. Starting at 50 atmospheres pressure and room temperature, the effect comes in abruptly when the proportion reaches 0·65 per cent. It is apparently a knock effect which may be eliminated by raising the bomb temperature to 100° C. When the proportion of hydrogen exceeds 1 per cent, this apparently catalytic effect of the hydrogen is replaced by the normal additive effect due to the admixture of a fast-burning hydrogen-oxygen mixture. A somewhat similar result follows the addition of steam up to 1 per cent, although the accelerative effect of hydrogen is the more marked. The slowing down of combustion when air is employed is ascribed to the nitrogen, for it does not occur when argon is substituted. With D. M. Newitt and C. M. Smith it was shown that the explosion limits of carbon monoxide-air mixtures when dry were narrowed by increasing the initial pressure from 32·2 to 64·4 atmospheres. With moist mixtures, increasing the initial pressure displaces both the upper and lower limits downwards without altering the explosion range.

CONSTITUTION OF COAL.—One of the methods of studying the constitution of coal is to examine the results of treating the fuel by organic solvents which, especially at high pressures, extract some of the coal substance. The extract may be resolved into several oily and solid fractions, and considerable discussion has ranged round the question as to whether one of these, and which, is responsible for the coking properties of a coal. It has been questioned whether the extraction made at 285° C. is purely physical or brings about a decomposition of the coal. Prof. W. A. Bone, L. Horton, and L. J. Tei, according to a paper presented before the Royal Society on Nov. 1, believe that no such decomposition occurs, and in this agree with the observations of other workers who find decomposition setting in only above 300° C. The extracted matter pre-exists as such in the coal. The authors found that the soft oily portion of the extract does contribute to the coking, although this is chiefly bound up with a solid fraction of the extract. From an examination of coals of varying geological age, it was concluded that the oily extracts are obtainable from the younger coals. The counterpart of the solid extract found in the less mature coals is of a phenolic character.

The Corrosion of Condenser Tubes.

THE Seventh Report to the Corrosion Research Committee of the Institute of Metals (*J. Inst. Metals*, **32**, 81; 1924) rendered it increasingly clear that corrosion (and resistance to corrosion) depends to a very great extent on the behaviour and properties of films, consisting chiefly of corrosion products, which form more or less completely on the surface of the metal. The Eighth Report, recently published, carries this aspect of corrosion considerably further so far as one type of wastage is concerned, namely, the 'impingement attack' produced by rapidly moving sea-water, particularly where free air is present, or where intermittent cavitation occurs.

This form of corrosion is well known to engineers; it results in a water-worn appearance of the tubes, and is due to the erosion of the protective film. Such films, even where they cannot be seen, may be inferred, for example, where a clean specimen of an alloy suffers attack while a specimen of the same material, previously immersed in slowly moving sea-water for a few days, is unaffected. Up to the present the investigation of the properties of such films has been tedious and, to some extent, uncertain, and the development in the present report of a method of examination which is both rapid and direct represents an achievement of great value.

The fact that a specimen of metal, when covered with a layer of corrosion products, has an electrical potential different from that of the same metal in a clean condition was already well known, but the difficulties involved in the measurement of this potential are by no means inconsiderable. In order to avoid inaccuracies due to polarisation and variations in the electrical resistance of the film, some form of null method was required which would take only the smallest possible current even when out of balance. It was therefore decided to use a three-electrode valve for the purpose, an idea which is, of course, quite well known, but has worked extremely well. An ordinary Marconi Osram D.E.R. valve is used with 33 volts on the anode and a negative bias of 1·5 volts on the grid. A sensitive moving coil instrument is placed in the anode circuit to indicate changes of the anode current. A potential divider, in series with a resistance, is connected across the filament battery, and is arranged so that a potential of from 0 to 500 m.v. may be applied in opposition to the unknown potential when this is in series with the grid bias battery. The potential thus applied is shown by a second moving coil instrument. A change-over switch is placed in the grid circuit, as shown in Fig. 1. When the switch is in the right-hand position, the millivoltmeter and the portion of the potential divider in use are short-circuited, and the positive pole of the grid bias battery is connected direct to the negative lead to the filament. Under these conditions the anode current shown by the instrument in the anode circuit corresponds with the normal grid potential and is noted.

By moving the change-over switch to the left-hand position the potential to be measured is connected in series with the grid bias battery, making the grid more negative and causing the anode current to fall. The unknown potential is then balanced out by adjusting the potential divider, and the point of balance is shown when the anode current returns to the value previously noted. When this is the case the reading of the millivoltmeter gives the value of the unknown potential. A third set of contacts is arranged to open the anode circuit during the opetion of the change-over switch.

In carrying out potential measurements dur corrosion tests, the specimen used is a small disc, from a condenser tube, with a wire soldered to back. The discs are cemented into ebonite hold with Chatterton's compound, the wires from discs being run inside separate rubber tubes to sulate them from the sea-water or other corrod medium. The potential is measured between specimen and a calomel electrode placed in a separ vessel connected with the tank in which the corros is occurring by means of a syphon. As the measu ments are only relative, there is no need to use standardised calomel electrode, the one actually u being made up with sea-water instead of potassi chloride solution. This avoided the necessity of tak precautions to prevent the diffusion of the sea-wa into the electrode vessel.

In all the alloys tested, the calomel electrode l been the positive pole. The formation of a protect film makes the specimen more cathodic, with

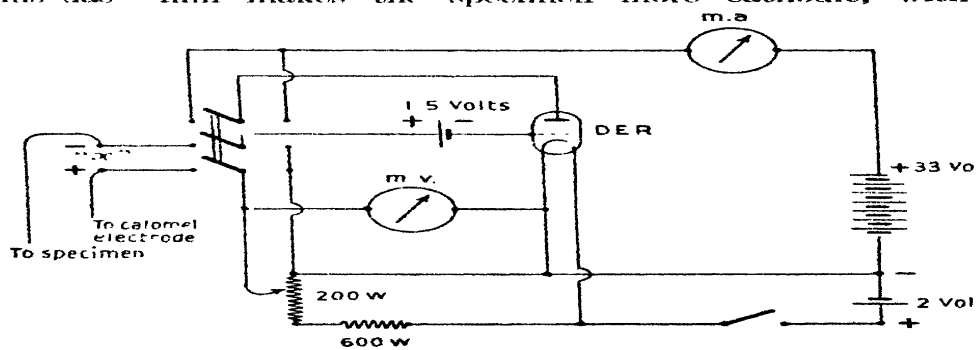

FIG. 1.—Circuit of valve 'potentiometer' used for measuring changes in 'film potenti during corrosion tests. By courtesy of the Institute of Metals.

diminishing potential difference between the specim and the electrode. The breakdown of the film in similar manner is shown by an increase of the diffe ence of potential. This difference has little dire practical significance of itself. What is of importanc however, is the potential difference between the fil covered metal and the same metal without a fil This may be described as the 'film-potential' whic therefore, is simply the electrode potential of tl clean metal minus that of the specimen covered wi a film. Obviously the film-potential increases film formation takes place and falls in the event of film breakdown (Fig. 2). For the purposes of tl present work it was taken that the clean metal w not very different from one freshly cleaned with sar paper or a steel brush.

In order to test the method, some experiments we carried out on a 70 : 30 brass tube containing 0·(per cent of arsenic and on a special brass tube co taining 2 per cent of aluminium. The curves obtain showed important differences in the behaviour of tl film on the two alloys, particularly when the film w scratched under conditions of violent air-bubb impingement. In the case of the ordinary brass th resulted in rapid attack, but in that of the aluminiu brass the injury healed up and the potential reache the original figure in less than twenty-four hours.

Having thus developed a method capable of yielding rapid and conclusive results, the work was continued on more practical lines, the main results of

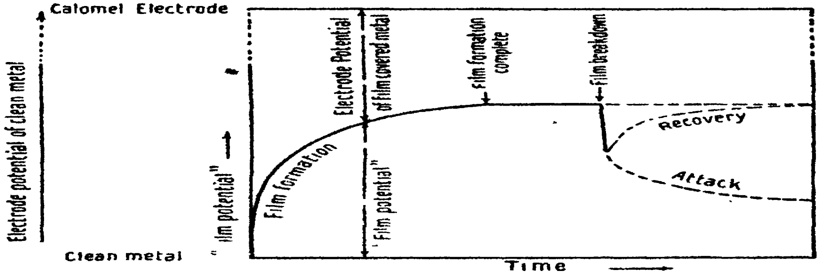

FIG. 2.—Diagrammatic curve of 'film potential' plotted against time, showing the relationship between 'film potential' and electrode potential. By courtesy of the Institute of Metals.

which may be summarised. It is shown in the first place that, even where there is no intermittent cavitation, that is, the collapse of 'vacuum bubbles,' impingement attack can still take place as a result of air-bubble impingement. The size of these air-bubbles plays an important part in causing this type of corrosion, and, where the bubbles entangled in the water are very small, they appear to be comparatively harmless even under conditions of strong impingement. There are, therefore, two main causes of impingement attack, intermittent cavitation and air-bubble impingement, but in both cases the effect is known to be dependent on the occurrence of swirling motions in the water. Rotatory motion of the water should therefore be prevented both in the inlet water-box and inlet piping, if necessary by positive arrangements to guide the water. Air bubbles in the water, except very small ones, should be avoided, and the suggestion is made that a grid in front of the tube-plate of the condenser may be so designed that any bubbles passing through it are broken up sufficiently finely as to be harmless when they enter the tubes.

When the conditions cannot be moderated by mechanical means, the most hopeful solution of the problem would appear to be the use of tubes of a material specially resistant to this form of attack. Of such tubes already on the market those of 70 : 30 cupro-nickel seem to be quite satisfactory, but other materials, such as the aluminium-brass, to which attention has already been directed, appear to be at least as good.

F. C. T.

The Swedish State College of Forestry Centenary Celebrations, 1928.

ON Oct. 14–16 the State College of Forestry, situated in the vicinity of Stockholm, celebrated its centenary. This College, formerly known as the Forestry Institute, was founded on Oct. 15, 1828, by that far-seeing man, Israel Adolf av Ström, who even at that distant date endeavoured to arouse his countrymen to a realisation of the economic importance of the forests of the country. The change in materials used for construction, especially in ships and buildings, witnessed the rise in demand for coniferous timbers, and during the second half of last century Sweden was mainly occupied in capturing and maintaining her hold on the European softwood timber markets. The advice of the few, who understood the danger which the more or less unrestricted lumbering in the forests which had been acquired by the great timber companies and in those numerous areas of varying size (designated farm-forests), owned by tenant farmers, went unheeded. The power of the lumbering interests predominated and the country undoubtedly prospered thereby. Before the end of the century, however, the Government became alarmed at the position and appointed a committee to consider what legal restrictions could be placed on the unchecked exploitation combined with a want of effective management in the greater bulk of the privately owned forests of the country. As a result of the committee's report a General Forest Law was enacted in 1903 and brought into force in 1905, which made it imperative that all areas of forest felled should be replaced by a new young tree crop within a reasonable period. At the same period a revival in the scientific aspects of forestry took place, and in order to endeavour to associate the scientific and commercial aspects of this question the Swedish Forestry Association was founded in 1903.

It is not the purpose of this notice to trace the great progress which the present century has witnessed in forestry matters in Sweden. The War acted as a setback to some extent, in so far that fellings were greatly increased to take advantage of the fantastic prices prevailing in the European markets. But perhaps, as a natural outcome of the extraordinary fellings made to take advantage of exceptional prices, the swing of the pendulum focused the attention of both the State authorities and those engaged in and dependent upon the enormous export trade upon the question of their ability to maintain the position, one vital to the country. To Great Britain the matter is of considerable importance, since we depend at present for a considerable amount of our coniferous imports—timber in various semi-fashioned and fashioned forms, pit-wood and, to an increasing degree, wood-pulp.

This being the position, it is not surprising that in the forestry revival the State College of Forestry became an important centre, since the State forestry probationers are trained there, and many of the larger timber companies either select fully-trained young men from the College or nominate their own probationers to proceed to the College. In some cases those men remain for a longer period as research students at the centre before joining their companies; for many of the latter undertake forest research work of their own and have their own research laboratories. This has been necessitated since conditions vary in different parts, and it is well recognised that it is impossible to localise forestry research for the whole country at any one centre. The timber companies of Sweden own a considerable portion of the most valuable forest land, the State forests occupying for the most part the less valuable soils in the north. The companies have a large capital invested in their undertakings and they have now realised to the full, a recognition which has only come slowly with the lumbering interests and is still absent in many parts of the world, that if this capital is to be safe in the future they must reafforest areas felled over so as to have a succession of crops to provide materials to keep their mills and other industries running. In other words, that primeval forests cannot last for ever. Sweden had arrived at that realisation by the beginning of the present century.

The importance attached to the centenary celebrations of the State College is therefore understandable. The King of Sweden graced the proceedings on two occasions, whilst the Crown Prince was present

at most of the meetings, and presided at the State banquet, at which he gave an excellent résumé of the present position of forestry in Sweden and the enormous importance of the forests to the country, half of the exports of which consisted of forest produce in one form or another. The Crown Prince showed that he had a first-hand knowledge of the question; the best summary of his speech being the remark: "If you properly manage your forests they will be preserved for all time."

The chairman of the College Board, as also of the Forestry Association, was that remarkable man Admiral Arvid Lindman, recently appointed Prime Minister of the country. The Admiral spoke several times and laid especial stress on the great importance of the work the State Forestry College was accomplishing, and that it now held an unquestioned positi in the country; and nowhere less unquestioned th amongst the great commercial industrial elem dependent upon the forest for the raw product their industries, as the indispensable centre at wh forestry education in all its aspects was conduct and that its functions were yearly becoming m valuable to the country.

The celebrations were attended by importa delegations from universities and forestry colle from most of the European centres, namely, Germa Great Britain (from the Universities of Oxford, Ca bridge, and Edinburgh), France, Austria, Belgiu Czechoslovakia, Yugoslavia, Poland, Soviet Rus Finland, Norway, Latvia, etc., with two representati from universities of the United States.

Radioactive Changes and Thermionics.[1]

H. J. BRADDICK AND H. M. CAVE.—The rate of emission of alpha particles from radium. A knowledge of the rate of disintegration of radium as measured by the number, Z, of α-particle disintegrations taking place in unit mass of radium in unit time is of considerable importance in the interpretation of radioactive changes, and in particular of the energy relations involved. Recently published values for this quantity Z range from $3{\cdot}40 \times 10^{10}$ to $3{\cdot}72 \times 10^{10}$. The heat evolution of radium and its products as determined experimentally is in agreement with that calculated from the number and energy of the α-rays, recoil atoms, β- and γ-rays if a value is assumed for Z of about $3{\cdot}7 \times 10^{10}$.

The authors have made a determination of the number Z by measuring the total charge carried by a known fraction of the α-rays from a source of radium active deposit, assuming that the normal α-particle carries twice the electronic charge, taken as $4{\cdot}77 \times 10^{-10}$ e.s.u. The experiment was carried out in a highly evacuated chamber placed in a strong magnetic field which served practically to eliminate β-ray and δ-ray effects. The α-ray current was measured by the Townsend compensation method, and the activity of the source was determined continuously throughout an experiment by γ-ray methods. Possible sources of error were investigated.

The value obtained is $3{\cdot}68 \times 10^{10}$ and leads to a value for the heating effect in good agreement with that observed in recent experiments. It seems that there is no necessity to assume the existence of an unrecognised heat-producing mechanism in the disintegration.

P. WHITE AND G. MILLINGTON.—The velocity distribution of β-particles after passing through thin foils. The source of β-particles was radium-B and -C on a narrow platinum wire, and their velocities were measured by the usual photographic method with semi-circular focusing. The source was covered by a thin screen of mica pierced with two or three small holes, the straggled and the unstraggled lines being obtained on the same plate. The relative number of particles falling on each part of the plates was determined from the density curves by using the known density-calibration curve for the plates. The frequency curves so obtained were corrected for the finite width of the unstraggled lines, and the abscissæ expressed as $\delta(H\rho)$. The curves for $H\rho$ 1410 to 1938 for thicknesses of mica 2 to 6 mgm. per sq. cm. are expressed in terms of a fundamental straggling curve. It is found that many more particles lose large amounts of energy than theory predicts. The relation between the most probable loss of velocity and the thickness of foil shows a small systematic divergence from Bohr's theory which is beyond limits of experimental error, and the same is fou for the relation between initial velocity and the m probable loss of velocity. The assumptions und lying Bohr's theory are discussed in relation to th divergences and the possible advances to be made the theoretical side.

N. A. DE BRUYNE.—The action of strong elect fields on the current from a thermionic cathode. account is given of an investigation into the rise the saturation current from a thermionic cathode fr a hot tungsten filament as the applied field is increas Schottky's relation holds good for fields up to million volts per centimetre; it is concluded that electrons pulled out by fields of this magnitude h a Maxwellian velocity distribution.

In the case of one of the three filaments used th was an apparent departure from the Schottky r tion; the only reasonable explanation of the anom is that at high field strengths produced adventitiou by the presence of irregularities on the cathode surf the Schottky relation no longer holds good; it therefore concluded that the electrons pulled out strong fields do not have a Maxwellian velocity tribution. From the results a value of the electro charge is deduced.

J. C. MCLENNAN AND G. GREENWOOD.—The composition of ammonia by high speed electro In these experiments, carried out with a Colli cathode ray tube, the pressure range studied 0·5-4·0 mm. On bombarding ammonia at pressu within this range an equilibrium between hydro nitrogen, and ammonia was established. By the of rays of constant velocity the percentage dec position decreased with increasing gas pressure. W the initial pressure of the gas was kept constant the velocity of the rays varied, the percentage dec position was found to be a linear function of voltage applied to the cathode ray tube. No dec position was found to occur below 82,000 v apparently because no rays with less speed penetra the window. The presence of an excess of nitro increased the quantity of ammonia decomposed, w the presence of excess hydrogen lessened it.

Analysis of the results obtained showed that e electron having a definite velocity depending on constant applied voltage was responsible for the composition of a definite quantity of ammonia m cules regardless of the pressure of the gas. V electrons of different speeds the amount of amm decomposed per electron increased with the sp When the ammonia contained nitrogen in excess, primary decomposition of the ammonia was affected by the presence of the nitrogen. V hydrogen in excess, however, the speed of the in decomposition of the ammonia was decreased.

[1] Abstracts of papers read before the Royal Society on Nov. 1.

Proposed New Constitution for Belgian Telegraph and Telephone Administration.

THE Minister responsible for the Belgian telegraph and telephone services, which at the present time are conducted by a self-contained department of the Ministry of Railways, Marine, Posts, Telegraphs, Telephones, and Aeronautics, has presented a report to his government indicating some of the difficulties which are experienced in providing adequately for the public needs in relation to these two services under the existing organisation of the department. Particularly, it has been found that the provisions of a law of 1846 dealing with the State finances are not sufficiently elastic to permit of the existing telegraph and telephone systems being maintained and developed with the degree of efficiency necessary in an undertaking of a commercial and industrial character, and consequently a new constitution is required for the conduct of these services. At the same time it is considered essential that the public telegraph and telephone systems in Belgium should continue to remain under State control.

The Belgian Government has been impressed with the arguments advanced in the report above mentioned in favour of the proposed reorganisation, and recognises the need, not only from the point of view of the economic life of the country, but also from that connected with the restoration of the nation's financial stability, for immediate action being taken to alter the present arrangements for carrying on these two important services. Accordingly a Bill, which the Government states is of an urgent nature, has been introduced by it in the Belgian Senate providing for the creation of a new "Telegraph and Telephone Administration."

It is the intention of the Belgian Government that the proposed Telegraph and Telephone Administration shall be endowed with the legal status of a corporation, which will have imposed upon it the duty of conducting the public telegraph and telephone services, including wireless, in the national interest, on lines similar to those in vogue in up-to-date industrial and commercial undertakings. The framers of the Bill have sought to remove, so far as it is possible to do so, the risk of a conflict between the State and the proposed Telegraph and Telephone Administration.

The Bill provides that the management of the Telegraph and Telephone Administration shall be entrusted to a board or commission, of which the Minister in charge of the telegraph and telephone services, or his deputy, is to be the president. There are to be eighteen other members, and it is expressly laid down that three of them shall be selected by reason of their special knowledge of the technical side of the problems connected with these services. Of the remaining members, eleven are to be chosen from lists prepared by certain Chambers of Commerce and other important institutions, whilst one member is to be nominated by the Finance Minister, and three others, who must be on the staff of the Telegraph and Telephone Administration, are to be nominated by the president of the commission. The existing telegraph and telephone networks will be transferred to the commission, which will make payments to the Belgian State Treasury in accordance with the provisions of the proposed law, which deals fully with the method in which the public telegraph and telephone undertakings are to be financed. The text of the Bill, *in extenso*, has been published in the issue of *L'Echo de la Bourse* (of Brussels) for Oct. 22, 1928.

The Faraday Society.

CELEBRATION OF THE TWENTY-FIFTH ANNIVERSARY.

AN event of considerable importance and interest in the world of science is the twenty-fifth anniversary of the foundation of the Faraday Society. This was celebrated on Friday, Nov. 9, first by a luncheon which was attended by representatives of scientific institutions from the leading countries of the world, and then by the delivery of the first Spiers Memorial lecture by Sir Oliver Lodge at the Royal Institution. Prof. T. M. Lowry, president of the Faraday Society, presided at the luncheon, at which were representatives of the Union Internationale de Chimie Pure et Appliquée, the Bunsen Gesellschaft, the American Chemical Society, the National Research Council of Italy, the Institute of Physics, the Institution of Electrical Engineers, the Physical Society, and others.

During the course of the speeches at the luncheon, Prof. E. C. Biilman, representing the Union Internationale de Chimie Pure et Appliquée, presented to the Faraday Society two volumes containing correspondence between Oersted and the technical societies, and also between him and Faraday. One other item of interest during the luncheon proceedings was the great compliment paid to the late Mr. F. S. Spiers for his organisation of the general discussions of the Faraday Society—which it was suggested were rendered the more valuable by the co-operation of men of science in other countries—and the suggestion of the president that there might be organised international general discussions which would take place alternately in different countries.

Sir Oliver Lodge took as his subject for the first Spiers Memorial Lecture, "Some Debatable Problems in Physics," in which he first discussed the seat of the electromotive force in the voltaic pile. He related something of the discussions that have taken place upon this matter, and commented on the fact that they have continued throughout the nineteenth century and are continuing into the twentieth. At the same time, he rather suggested that although there have been acute differences of opinion on the matter, the advocates of the different points of view are really much of the same opinion, and some of the difficulty has been introduced by different modes of expression. Indeed, taking Poynting's diagram of energy paths, Sir Oliver suggested that this is a complete reconciliation of the views on both sides and justifies the rival views. It indicates, said Sir Oliver, that the rival views have a great deal in common, but that those who have been expressing them have not done so in the most convenient way. It is legitimate but not convenient to define potential as that in the air near the metal; if we do that we get into trouble.

In the latter part of the lecture Sir Oliver Lodge dealt with one or two matters indicating how small effects observed in the laboratory become very important as time goes on. He commented on the fact that the contact of two metals, as in the voltaic pile, led to modern electrical generation, and how closely the small observation of Becquerel on spontaneous radioactivity is related to atomic disintegration. From this he passed on to the dissipation of energy, and asked the question whether, after all, matter does turn into radiation and that that is the end of it.

It is, he said, a debatable point; is it really an irreversible process? Is it not possibly and conceivably a reversible process? Are there any possible circumstances in which radiation can turn back again into matter? Sir Oliver suggested that irreversibility is not proved, and that the material universe may be a cyclical process after all. Matter has been clashing together under gravitation, developing heat; that seems to be irreversible, but how does the energy get back? Not as matter. If at the confines of the earth the heat so developed could be turned back again into matter, it could form a sort of continual pulsation and cyclical change without beginning and without end.

Sir Robert Hadfield, who was in the chair at the Royal Institution, and with his usual keenness for the affairs of the Faraday Society had prepared an interesting little brochure giving the history of its development and work, mentioned an important matter in connexion with the Royal Institution. There are plans in hand, he said, for improving the building which it is very necessary should be carried out, and he expressed the hope that all the technical and scientific societies would give every assistance in the matter. Sir Robert referred in his pamphlet to important work which has been accomplished by the Faraday Society during the twenty-five years of its existence, laying special stress on its contributions to the solution of the problem of the fixation of nitrogen. When the Nitrogen Products Committee was formed in 1916, largely at the instance of the Faraday Society, ... Society was directly represented, and no less ...n seven other members were also members of the ...iety, while many of those concerned in the work of ...t Committee now occupy prominent positions.

[U]niversity and Educational Intelligence.

[B]IRMINGHAM.—The Huxley Lecture for 1929 is to [be] delivered by Sir Humphry Rolleston on Feb. 12, [the] subject being "The Nature of Disease."

[T]he James Watt Fellowship for 1929 has been [aw]arded to Mr. D. Watson.

[C]AMBRIDGE.—Dr. T. D. Cockcroft, Clerk Maxwell [Stu]dent in the University, has been elected to a [Fell]owship at St. John's College.

[T]he Regent House has decided to accept the offer [of] the International Education Board of a gift of [...]00,000 towards the proposed new library and for [the] development of physical and biological studies. [De]tails of the scheme were given in our issues of [Oc]t. 6, p. 556, and Oct. 20, p. 632.

[E]DUCATIONAL relations between the United States [an]d Germany will be fostered by a tour to take place [nex]t summer under the joint auspices of the Inter[nat]ional Institute of Teachers College, Columbia Uni[ver]sity, New York City, and the Central Institute for [Ed]ucation and Instruction, Berlin. Assembling at [Ha]mburg or Bremen, the party are to visit, during the [...] weeks beginning June 17, schools of different types [in] various cities under the official direction of the [Ger]man educational authorities, proceeding afterwards [to] conference of the World Federation of Education [Ass]ociations at Geneva, to be held during the last week [of J]uly.

[TH]E Committee of the Leplay House Educational [Tour]s Association announces that during the Christmas [vaca]tion a group for historical and social studies will [go] to Lisbon, under the leadership of Mr. Barry Parker, vice-president of the Town Planning Institut[e]. Burgos, Madrid, and Toledo, and other places in Spai[n] are included in the itinerary. Further, Prof. [P.] Geddes has again invited friends of Leplay House t[o] go to Montpellier. A few days will be spent i[n] visiting Avignon, Nîmes, and other places of interest. Mr. G. Morris will lead the group. Particulars can b[e] obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

FROM the Universities Bureau of the British Empir[e] we have received a copy of a useful prospectus fo[r] 1928–29 of the professional schools, post-graduatio[n] courses, and specialist studies in the universities an[d] university colleges of Great Britain and Ireland. Thi[s] pamphlet gives, in forty pages, first, a summary of in[-]formation under those headings regarding each uni[-]versity (except Oxford and Cambridge) and universit[y] college; secondly, combined lists of their professiona[l] schools under the headings—theology, law, medicine, dental science, veterinary science, pharmacy, music, art, architecture, journalism, librarianship, commercial science, engineering, metallurgy, mining, agriculture, etc., and education; and, lastly, alphabetical lists of subjects of study to which special attention is devoted in the several institutions. By reference to these lists one can ascertain at a glance where special facilities are to be found for the study of, for example, aviation and aero-engineering (Cambridge, London—Imperial College and East London College—Oxford, and Glasgow), colloidal chemistry (Bristol, Leeds, and Manchester), economic entomology (Liverpool, London, Manchester, and Edinburgh), photography (Manchester), and so on. This pamphlet will no doubt be distributed to universities in other countries, where it should prove extremely useful to advanced students proposing to study abroad.

THE Board of Education has published another of its useful booklets, this time on the supply of literature—that is, reading books and libraries—for public elementary schools ("Books in Public Elementary Schools." Pp. xxii + 163. London: H.M.S.O. 1s. 3d. net). It starts from a statement of the admitted inadequacy of the expenditure of the authorities under this heading. The Board's Committee is able to make out an unanswerable claim. The expenditure on books only averages 1s. 7¾d. a head, taking elementary schools of all grades in England and Wales together. In the central schools alone, that is, the schools for scholars from twelve to fifteen or sixteen years of age, it amounts to just under five shillings. Even this is small enough, and for the other schools the amount is ludicrous. The report is emphatic that children in elementary schools need more books and books of better quality, though a steady improvement in the quality is noticed. Of the many detailed suggestions that are made it is only possible to mention one or two. There should be a collection of books of reference in every school, both for pupils and teachers, and children should be taught as part of their education how to make use of a book of reference. Arrangements are also suggested by which each pupil might acquire a small selection of books which especially interest him. The last recommendation is that special attention should be given in training colleges to guiding teachers in the right principles for the selection of books, for on them ultimately the choice of nearly all the books in an elementary school must rest. A regret seems justified that no one on the Committee was specially interested or qualified on the subject of books on science, and hence this section, and that on science and invention in the section on history, are conspicuously weaker than the rest.

Calendar of Customs and Festivals.

November.

SEED-TIME IN ANCIENT EGYPT.—The sowing of the corn in ancient Egypt, which took place in November, was observed by the farmer, according to Plutarch, as a period of mourning and solemn observance. It was also at this time of the year that a feast of lights was held at night, and the death of Osiris was displayed as a mystery at the grave of the god at Sais. Frazer suggests that the 'Feast of Lights' may have been an 'All Souls' festival. The people mourned and beat their breasts in their sorrow for the death of the god, and an image of a cow made of gilt wood, with a golden sun between its horns, was carried out of its chamber. In Plutarch's day it was carried seven times around the temple. This was held to symbolise the search of Isis for the body of the god Osiris.

Plutarch also records that during the four days from the thirteenth to the sixteenth of the month Athyr (November) the people mourned for Osiris, when the image of the cow was swathed in black. Osiris was said to have been killed on the seventeenth of the month. On the nineteenth day the priests, accompanied by the people, went down to the sea carrying a shrine containing a gold casket into which they poured fresh water, whereupon the spectators shouted that Osiris was found. After that, vegetable mould was made into the shape of a moon and robed and ornamented. This represented the dead god come to life.

The ritual, as is apparent from the various accounts that have come down to us, varied from place to place. According to the account of the Denderah inscription, which describes the ceremonies of the Ptolemaic period, they lasted eighteen days, from the twelfth to the thirtieth day of the month Khoiak, and represented the death, dismemberment, and resurrection of Osiris. The ceremony began with ploughing by two black oxen, and the sowing of barley, spelt, and flax, and included a voyage of Osiris, attended by thirty-four images of deities in thirty-four tiny boats of papyrus, illuminated by three hundred and sixty-five lights. On the thirtieth day the effigy of the god was laid to rest in a sepulchral chamber, the effigy of the previous year having already some days before been removed and placed on boughs of sycamore. In a chamber of the temple of Isis at Philæ, the resurrection of Osiris was symbolised in a representation of the body of the god from which sprang stalks of green corn (see Frazer's "Golden Bough," Abridged Edition, p. 371 *foll.*).

November 23.

ST. CLEMENT, a follower and coadjutor of St. Paul, said to have been thrown into the sea with an anchor round his neck; hence his emblem of an anchor. On the sea retiring miraculously for a distance of three miles, his body was found within a stone chest in a chapel, and in commemoration the miracle of the retirement of the sea was repeated annually for a period of seven days. St. Clement's day in the popular calendar was regarded as the first day of winter. In medieval times it was the custom for children to parade the streets on this day. In Worcestershire boys went from house to house collecting pence and reciting verses in honour of both St. Clement and St. Catherine. Sometimes they were accompanied by men, who received gifts of cider and ale. This appears to be a relic of an older custom by which, on the night of St. Clement, house-to-house visits were paid for the purpose of drinking ale. In the Clog calendars the day was marked with a pot, as an indication of the character of the festival.

A similar procession of children asking for doles of cakes, a custom known as 'souling,' takes place in connexion with Hallowmas (see Oct. 31 and Nov. 1 and 2) and also in connexion with the feast of St. Katherine (Nov. 25). The customs still survive in Cheshire, Staffordshire, Shropshire, and Warwickshire. 'Clementing' has been recorded in East Sussex, and in a proclamation of 1540 the custom of children making processions on St. Nicholas, St. Katherine, St. Clement, the Holy Innocents, and such like days, was forbidden.

It has been suggested that the economic aspect of the Celtic New Year on Nov. 1, when dues of agricultural produce were payable, has been transferred under Christian and ecclesiastical influence to the feasts of St. Clement and St. Katherine. Nov. 23, old St. Martinmas, was recorded in 1812 as still observed as one of the ancient quarterly periods of the year on which a few rents still became payable. In Walsall, in a code of 1440, St. Clement's day was the date for the rendering of the Mayor's accounts, the wardens of the guilds making up their accounts on St. Katherine's day. Down to a late date the day continued to be known as St. Clement's accompt, and apples and nuts were thrown from the Guildhall windows to the crowd. It is therefore probable that the ale given to the men and the apples given to the children are a relic of the entertainment frequently recorded as given to those paying dues.

St. Clement is the patron saint of blacksmiths, to whom he was known as 'Old Clem.' At one time his feast was celebrated annually in the dockyard at Woolwich by the election of one of the apprentices to serve as Old Clem. His face was masked, his head covered with an auburn wig, and he wore a long white beard. He sat in a large chair covered with bunting, with a wooden crown and anchor above it. A wooden anvil was before him, and in his hands he had wooden tongs and hammer. A mate with wooden sledge and others with banners and torches, battle-axes, etc., attended him. The party then formed a procession, Old Clem being shouldered, and paraded the town, visiting the residences of the officials of the dockyard and asking alms, the proceeds being spent in a supper.

MOCK MAYORS.—Mr. Frank H. Perrycoste of Polperro writes in reference to Mock Mayors in Cornwall (see NATURE, Sept. 29, p. 497), that he has recently found a note that on June 8, 1797, Sir Harry Trelawny paid William May 2*s.* for attending at Pelynt to prevent the Mayor's chairing. Mr. Perrycoste suggests that this was a payment to the parish constable or an official for his services in preventing any riot or undue disturbance at the annual election of a mock mayor at Pelynt, a small agricultural village near Polperro.

Cornwall is not the only county in which the election of a mock mayor is recorded. At the beginning of the last century at Weston, a parish near Bath, such an election used to take place annually after a dinner, when the mayor entered the hall in full procession and, after the administration of the oath, an armed champion threw down a glove in challenge. Documents from the charter chest were recited, including the original charter, "granted by Julius Caesar." A similar election took place in connexion with the 'Renwick Mop' at Randwick, Stroud, on the Monday after Low Sunday, *i.e.* the second Monday after Easter. This latter was a water ceremony, the mayor being carried in a chair to a pool near a church, when he was lowered until his feet touched the water, while he and the bystanders were drenched with water.

Societies and Academies.

LONDON.

Royal Society, Nov. 8.—S. B. Schryver and E. J. Candlin: Investigations on the cell-wall substances of plants, with special reference to lignification. Substances accompanying cellulose in plant cell-walls may be divided into three classes: (i) lignins, (ii) hemicelluloses, (iii) pectins. Products belonging to the two latter classes are formed by conjugation of sugar acids (glycuronic and galacturonic acids) with sugars. These acids are designated 'uronic acids,' and hemicelluloses and pectins appear, therefore, to belong to a distinct chemical group, for which the name 'polyuronides' is suggested. Pectins undergo decarboxylation on treatment with weak alkaline solutions, even at room temperature, yielding among other products, hemicelluloses, still containing uronic groups, but resisting decarboxylation on treatment with alkalis, and resembling in all respects hemicelluloses isolated directly from timbers. The results indicate that decarboxylation takes place when plant tissues lignify.

R. R. Gates and F. M. L. Sheffield: Chromosome linkage in certain *Œnothera* hybrids. An account is given of five generations of hybrids from *Œ.* (*biennis* × *rubricalyx*) × *ammophila* and *Œ. ammophila* × (*biennis* × *rubricalyx*) and their cytological peculiarities. The chromosome linkages appear to be a means of explaining some of the genetic behaviour observed in these and similar hybrids. Reciprocal F_1 hybrids are very different. They are patroclinous. It may be that the *Œnothera* linkage arose between non-homologous chromosomes. It appears probable that a relation exists between the chromosome linkage and the genetic linkage which is a characteristic feature of the genus.

S. Dickinson: Experiments on the physiology and genetics of the smut fungi. After isolating a chlamydospore of the covered smut of oats (*Ustilago levis*) and allowing it to germinate, the first sporidium formed by each of the four segments of its promycelium was isolated, transferred to test-tube slopes, and allowed to develop. Four cultures of strains were obtained from one chlamydospore, and all four differed. The segregation of these cultural characters was on a 2 : 2, 3 : 1, and 4 : 0 basis. This may take place in either the first or the second of the reduction divisions. No conclusive evidence of somatic segregation has yet been obtained. The cytoplasm has no determining influence on cultural characters so far described.

R. J. Ludford and W. Cramer: The mechanism of secretion in the thyroid gland. The cells of the thyroid discharge into the lumen of a vesicle and so into the blood stream. There is no alteration of direction of discharge during prolonged increased functional activity. There is no evidence that the cells secrete normally direct into the capillaries. In exophthalmic goitre, in mouse and man, there is enlargement of mitochondria and of Golgi apparatus—a condition characteristic of intense secretory activity. The polarity of the Golgi apparatus is frequently reversed. The secretion droplets, formed in association with the reversed apparatus in the case of the mouse, are discharged direct into the capillaries.

Ruth Deanesly: A study of the adrenal cortex in the mouse and its relation to the gonads. Well-marked normal changes are described in the cortex of the female gland which show no correlation with oestrous cycle in the unmated animal. Pregnancy accelerates these normal changes, but has no specific effect on the structure of the gland. In the castrated male an adrenal of female type develops. Ovariotomy has no effect on the adrenal. Double adrenalectomy was performed on a number of male and female mice: these bred normally after operation.

W. J. Dakin: (1) Anatomy and phylogeny of *Spondylus*, with a particular reference to the lamellibranch nervous system. An investigation of the bivalve mollusc, *Spondylus*, was undertaken in order to determine the relationship of this genus to *Pecten*, for although *Spondylus* possesses eyes of a type almost or exactly the same as those of *Pecten*, the habits of the two genera are very different. *Spondylus* lives fixed by its shell to submerged rocks, etc.; *Pecten* moves about actively and is able to swim. Anatomically *Spondylus* is a close relative of *Pecten*, and its structure can be best interpreted by assuming it derived from a form not unlike *Pecten maximus*. The nervous system differs remarkably from the type so familiar in all other lamellibranchs. The pedal ganglia are connected by long nerves to the visceral ganglion and cerebro-pedal connectives are not present as distinct nerves.

W. J. Dakin: (2) The eyes of *Pecten*, *Spondylus*, *Amussium*, and allied lamellibranchs, with a short discussion on their evolution. The eyes of *Pecten*, *Spondylus*, *Amussium*, *Chlamys*, and, in all probability, *Pedum* may be considered identical in structure. No lamellibranchs outside the suborder Pectinacea have eyes of the same type, and within the group the eye structure is remarkably constant, notwithstanding diversity of habits. The development of the eye throws little or no light upon its evolution. The eyes in the Pectinacea are functionally not so highly developed as their complex structure might lead one to suppose. Internal factors may have played a greater part in their evolution than natural selection.

C. E. Walker: Artefacts as a guide to the chemistry of the cell. When mixtures containing albumen, peptone, gelatine, and lipins, with minute globules of methyl myristate or laurate suspended in them to act as artificial nuclei, are suitably fixed and treated with osmic acid, lipins separate out and are deposited, largely near to the globules, and are blackened. If, however, yellow phosphorus be dissolved in the myristate or laurate, the greater part of the lipins is deposited upon the actual surface of the globules. This suggests that nuclear content may determine the position in which lipins are fixed. If these mixtures with myristate or laurate containing phosphorus are kept at a temperature of 30° C., lipins appear to become gradually saturated or oxidised, and appearances on fixation resemble the changes described as occurring in 'Golgi apparatus' in cells of animals suffering from 'phosphorus' poisoning.

PARIS.

Academy of Sciences, Sept. 24.—G. Bigourdan: The instruments and observations of Delambre at the rue de Paradis.—**V. Grignard, L. Lapayre, and Tchéou Faki.** The monomagnesium compound of acetylene. A study of Oddo's process, the reaction between C_2H_5MgBr and acetylene. Large increases in the yield can be obtained by working under certain conditions detailed.—**E. Bataillon**: Analytical studies on the maturation of the eggs of Batrachians. All the experiments described agree with the hypothesis of an osmotic hyperpressure in immature eggs.—**Georges Bouligand**: Order of measurement and dimension of closed ensembles.—**O. D. Kellogg**: The unicity of harmonic functions.—**Luis Roden**: A new method for measuring the solar parallax. This method is based

on measurements of radial velocities of rotation of the solar equator and observations giving the period of complete rotation. The solar diameter obtained by this method (1,390,857 km.) gives a figure for the sun's mean distance very close to those given by other methods.—**G. Bruhat**: The geometrical properties of diagrams relating to saturated vapours.—**Erik A. Holm**: The state called the 'Tama-Zustand.' From the hypothesis of Von Dallwitz-Wegner, it follows that in a vessel at a uniform temperature and containing a gas sufficiently rarefied, there should exist a pressure of a new order named the gravimolecular pressure. Experiments are described which appear to prove the existence of such a pressure.—**T. Peczalski** and **J. Cichocki**: The electrical conductivity of the vapours of potassium chloride. A detailed account of experiments leading to the conclusion that potassium chloride vapour can be electrolysed.—**R. de Mallemann**: Calculation of the internal field of polarisation.—**Paul Bary**: Structure of the filaments obtained by drying up ferric solutions. A study of the structure of the solid material obtained by the slow evaporation of aqueous solutions of colloidal ferric hydroxide.—**Jean Savard**: The ultra-violet absorption curves of the terpene alcohols in relation with their constitution.—**Albert Baldit**: Magnetic measurements in the south-west of France.—**Et. Burnet**: The pathogenic power of *M. melitensis* and of *B. abortus* for the ape and for man.

GENEVA.

Society of Physics and Natural History, July 5.—**Robert Bach**: A verification apparatus for optical pyrometers. The author has constructed a very simple apparatus, which is based on the realisation of an approximately black body and allows the standardisation of any optical pyrometer by the observation of a certain number of melting points, for arbitrary experimental conditions.—**Léon W. Collet** and **Augustin Lombard**: The presence of a plane of overlapping of the Morcles stratum in the circle of the *Fer à cheval* (Sixt Alps, Haute-Savoie). The sedimentary layer of the crystalline massif of the Aiguilles Rouges is represented to the south of the Fer à cheval hut by Trias and crushed Malm. On these rests the Morcles stratum which starts with thin schists of the lower Lias, supporting the limestone zones of the middle Lias.—**Léon W. Collet** and **Edouard Paréjas**: The crystalline wedge of Fontanabran, the massif of the Aiguilles Rouges. The gneiss which forms the summit of Fontanabran overlaps a lower crystalline element through the intermediary of the Triassic layer of the latter (quartzites and argilites). Further, the extremity of the wedge, broken by an Alpine direction fault (N. 45° E.), sinks about fifteen metres.

PRAGUE.

Bohemian Academy of Sciences and Arts, Class II. (Science and medicine), Oct. 19.—**V. Sotornik**: Minerals of alpine paragenesis from Kutná Hora.—**V. Posejpal**: Second contribution to the study of light-ether: Ultra-penetrating radiation, heat of the earth and sun, the source of Swanne's electrons keeping up the earth's negative charge, are accounted for by the hypothetical neutron constitution of the ether.—**O. Borůvka**: A certain type of minimal surfaces in four-dimensional space of constant curvature.—**J. Korous**: The series of Laguerre polynoms.—**J. Hronec**: Linear differential systems of second order solvable by hypergeometric series.—**V. Dolejšek** and **M. Valouch**: The precision of X-ray spectra and Moseley's law. The causes of irregular deviations from Moseley's law are due to variations of intensity, tension, and chemical binding; periodic regular deviations occur from the formula

$$\sqrt{\frac{r}{R}} = a + bn + cn^2 + dn^3 \ (n = \text{atomic number}).$$

—**M. Mikan**: Isologic complex of Cremona space quadratic transformations. On the quadratic correspondence of 12 pairs in space, and the reproduction of 6 points.

Official Publications Received.

BRITISH.

First Cape Catalogue of Stars for the Equinox 1925·0. Catalogue of 4569 Stars from Observations with the Reversible Transit Circle made at the Royal Observatory, Cape of Good Hope, during the Years 1918–1925, under the direction of Dr. H. Spencer Jones. Pp. xliii+128. (London: H.M. Stationery Office.) 27s. 6d. net.

Observations made at the Royal Observatory, Greenwich, in the Year 1926: Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. 10+Axxiii+A56+iv+B20+C40+Dix+D123+6+Exvi+E86+Fxi+F34+22. (London: H.M. Stationery Office.) 40s. net.

Declinations of Stars derived from Observations of Transits in the Prime Vertical with the Altazimuth in the Years 1923 26, under the direction of Sir Frank Dyson. Pp. v+64. (London: H.M. Stationery Office.) 7s. net.

Annals of the Cape Observatory. Vol. 10: Spectroscopic Researches. Part 8: Radial Velocity Determinations, including a Spectroscopic Determination of the Constant of Aberration, the Orbits of 13 Spectroscopic Binary Stars, and the Radial Velocities of 434 Stars. By Dr. H. Spencer Jones. Pp. 246. (London: H.M. Stationery Office.) 20s. net.

Magnitudes of Stars contained in the Cape Zone Catalogue of 20,843 Stars for Equinox 1900, Zones −40° to −52°. Reduced and prepared for Press under the direction of Dr. H. Spencer Jones. Pp. lxxxiv+140. (London: H.M. Stationery Office.) 26s. net.

Leeds University: Department of Pathology and Bacteriology. Annual Report, by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research, by Prof. R. D. Passey. Pp. 16. (Leeds.)

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, intended to be presented at the Annual Meeting of the Society, 31st October 1928. Pp. 42. (Newcastle-upon-Tyne.)

Board of Education. Educational Pamphlets, No. 64: Education for Industry and Commerce; a Survey of the existing Arrangements for Co-operation between Industry, Commerce and the Professions and the Technical School System of England and Wales. (Industry Series, No. 1.) Pp. 103. (London: H.M. Stationery Office.) Paper, 6d. net; cloth, 1s. 6d. net.

Empire Cotton Growing Corporation. Report of the Executive Committee, to be submitted to the Meeting of the Administrative Council on October 16th, 1928. Pp. 10. (London.)

Proceedings of the Society for Psychical Research. Vol. 38, Part 108, September. Pp. 103-207. (London: Francis Edwards, Ltd.) 8s.

Journal and Proceedings of the Asiatic Society of Bengal. New Series, Vol. 23, 1927, No. 2. Pp. clxxxiv. (Calcutta.) 4.8 rupees.

Rubber Research Institute of Malaya. Planting Manual No. 1: Guide to the Preparation of Plantation Rubber. By B. J. Eaton. Pp. iii+54+vii. (Kuala Lumpur.) 2 dollars.

Indian Journal of Physics, Vol. 3, Part 1; and Proceedings of the Indian Association for the Cultivation of Science. Conducted by Prof. C. V. Raman. Pp. 149+5 plates. (Calcutta.) 3 rupees; 4s.

King's College, London. 1829–1929 Centenary Commemoration. Pp. 82+6 plates. (London.)

Survey of India. The Tides. Revised by Major C. M. Thompson. Pp. vi+140+30+50. 2 rupees; 3s. 6d. Professional Paper No. 20: Reconnaissance Survey from Aircraft. By Lieut.-Col. G. A. Beazeley. Pp. ii+34+4 plates. 1.8 rupees; 2s. 6d. Professional Paper No. 21: Irrigation and Settlement Surveys, 1926. By Major J. D. Campbell. Pp. v+36+16 plates. 1.8 rupees; 2s. 6d. (Dehra Dun.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 12, Technological Series No. 7: The Foundations of Yarn-Strength and Yarn Extension. Part i. The General Problem; Part ii. The Relation of Yarn-Strength to Fibre-Strength. By Alfred James Turner. Pp. ii+29. (Bombay.) 1 rupee.

The Hadow Report and After: being a Statement by the Executive of the National Union of Teachers upon certain Recommendations of the Consultative Committee of the Board of Education, and upon the Reorganisation of the Educational System now contemplated by the Board. Pp. 71. (London: National Union of Teachers.) Free.

British Cast Iron Research Association. Seventh Annual Report for the Year ending June 30th, 1928. Pp. 24. (Birmingham.)

A Theoretical Study of the Articulation and Intelligibility of a Telephone Circuit: a Theoretical Study of the Quantities that can be used as a Measure of the Transmission Quality of a Telephone Circuit, and Formulae for determining the Relation between the different Quantities. By John Collard. Pp. 86. (London: International Standard Electric Corporation.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1164 (Ae. 328): Note on the Forces experienced by Ellipsoidal Bodies placed unsymmetrically in a Converging or Diverging Stream. By Dr. H. Lamb. (T. 2617.) Pp. 4+1 plate. (London: H.M. Stationery Office.) 4d. net.

Catalogue of Manuscripts in the Library of the Royal College of Surgeons of England. By Victor G. Plarr. Pp. ii+78. (London.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1926. Pp. v+149. (London: H.M. Stationery Office.) 4s. 6d. net.

Ministry of Health. Regional Water Committees. Pp. 8. (London: H.M. Stationery Office.) 4d. net.

Ministry of Health. Memorandum on the Accommodation for the Sick provided at certain Public Schools for Boys in England. By Capt. W. Dalrymple-Champneys. Pp. 35. (London: H.M. Stationery Office.) 1s. net.

Report of the Eighteenth Meeting of the Australasian Association for the Advancement of Science (Australia and New Zealand). Western Australian Meeting, Perth, August 1926. Edited by A. Gibb Maitland. Vol. 18. Pp. liv+918. (Perth: Fred. Wm. Simpson.)

The British Science Guild. Report of the Committee appointed by the British Science Guild to consider the Reform of the British Patent System. Pp. 48. (London.) 2s.

FOREIGN.

University of Illinois: Engineering Experiment Station. Bulletin No. 179: An Investigation of Checkerbrick for Carbureters of Water-Gas Machines. By Prof. Cullen W. Parmelee, Albert E. R. Westman and Wilbur H. Pfeiffer. Pp. 90. 50 cents. Bulletin No. 180: The Classification of Coal. By Prof. Samuel W. Parr. Pp. 62. 35 cents. Bulletin No. 181: The Thermal Expansion of Fireclay Bricks. By Albert E. R. Westman. Pp. 30. 20 cents. Bulletin No. 182: Flow of Brine in Pipes. By Richard E. Gould and Marion I. Levy. Pp. 26. 15 cents. Circular No. 17: A Laboratory Furnace for Testing Resistance of Firebrick to Slag Erosion. By Prof. Ralph K. Hursh and Chester E. Grigsby. Pp. 18. 15 cents. (Urbana, Ill.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 171: Farmers' Co-operative Buying and Selling Organizations in Michigan. By C. F. Clayton and J. T. Horner. Pp. 104. Special Bulletin No. 177: The Significance of Soil Variation in Raspberry Culture. By M. B. Hoffman and G. R. Schlubatis. Pp. 20. (East Lansing, Mich.)

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Vol. 16, pour l'année 1926. Pp. 47. (Copenhague: Andr. Fred. Høst et fils.)

Reprint and Circular Series of the National Research Council. No. 82: The Physical Causes of Deafness. Report of the Committee on the Physical Causes of Deafness. Part i. Method of Study, by Dr. Charles W. Richardson; Part ii. Statistical Studies of the Children in the Public Schools for the Deaf, by Dr. George E. Schambaugh, assisted by Dr. E. W. Hagens, Dr. J. W. Halderman and Dr. R. W. Watkins. Pp. 100. 1 dollar. Bulletin of the National Research Council. No. 64: The Coroner and the Medical Examiner. Issued under the Auspices of the Committee on Medicolegal Problems. By Oscar T. Schultz and Prof. E. M. Morgan; with a Supplement on Medical Testimony, by E. M. Morgan. Pp. 101. 1.50 dollars. (Washington, D.C.: National Academy of Sciences.)

Department of Commerce: Bureau of Mines. Fuel Briquets in 1927. By F. G. Tryon and J. M. Corse. (Mineral Resources of the United States, 1927, Part 2.) Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 67, No. 2. Pp. 105-197. (Philadelphia, Pa.)

Smithsonian Miscellaneous Collections. Vol. 75, No. 5: Cambrian Geology and Paleontology, V. No. 5: Pre-Devonian Paleozoic Formations of the Cordilleran Provinces of Canada. By Charles D. Walcott. (Publication 2965.) Pp. iii+175-368+plates 26-108. (Washington, D.C.: Smithsonian Institution.)

Methods and Problems of Medical Education. (Tenth Series.) Pp. iv+343. (New York City: The Rockefeller Foundation.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 22, Part 1: The Systematic Study on the Formosan Pyralidae. By Jinshichi Shibuya. Pp. 300+9 plates. (Tokyo: Maruzen Co., Ltd.)

University of California Publications in Zoology. Vol. 30, No. 12: Variations in the Fox Sparrow (*Passerella iliaca*) with reference to Natural History and Osteology. By Jean M. Linsdale. Pp. 251-384+plates 16-20. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1.85 dollars.

Bulletin of the American Museum of Natural History. Vol. 58, Art. 1: Chinese Fresh-water Fishes in the American Museum of Natural History's Collections. By J. T. Nichols. Pp. 62. (New York City.)

Japanese Journal of Mathematics: Transactions and Abstracts. Vol. 5, No. 2. Pp. ii+127-210+12. (Tokyo: National Research Council of Japan.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 8: Het Klimaat van Nederlandsch-Indië (The Climate of the Netherlands Indies). Door Dr. C. Braak. Deel 2 (Vol. 2), Aflevering 2 (Part 2): Java en Madoera (Java and Madoera). (With English Summary.) Pp. viii+157-309+69-185. (Weltevreden.)

Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam. Afdeeling Natuurkunde (Eerste Sectie), Deel 13, No. 5: Results of Observations of the Total Solar Eclipse of June 29, 1927. 1: Photometry of the Flash Spectrum. By A. Pannekoek and M. G. J. Minnaert. Pp. 106. (Amsterdam.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 42: Ensuigata-Rappa no Onkyôgakutekino Seisitu ni tuite (On the Acoustical Properties of Conical Horns). By Satô-Kôzi. Pp. 19. 0.31 yen. No. 43: Theory and Design of a New Carburettor. By Masakiti Isikawa. Pp. 21-67. 0.51 yen. (Tokyo: Kôseikai Publishing Office.)

CATALOGUES.

No. 445: Old Time Literature (principally XVIIth and XVIIIth Century). Pp. 60. (Cambridge: Bowes and Bowes.)

Imperial Plates for Process Work. Pp. ii+26+7 plates. (London: The Imperial Dry Plate Co., Ltd.)

Bulletin des publications nouvelles. 2e Trimestre 1928. Pp. 24. (Paris: Gauthier-Villars et Cie.)

Eastman Organic Chemicals. List No. 19, October. Pp. 87. (Rochester, N.Y.: Eastman Kodak Co.)

Candex Hot Cathode X-ray Tubes. Pp. 8. (London: Cuthbert Andrews.)

Books about Books: Bibliography and Modern Private Presses. (No. 511.) Pp. 77. (London: Francis Edwards, Ltd.)

Scientific and Technical Books: a Classified Catalogue of the Publications of Ernest Benn, Ltd. Pp. 82. (London: Ernest Benn, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 16.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital Medical School), at 5.—V. B. Reader: A Third Factor Present in Marmite, necessary for the Nutrition of the Rat.—H. J. Holman and Prof. S. B. Schryver: The Separation of the Basic Products of the Hydrolysis of Proteins.—J. R. Marrack: Ketosis in Sea-sickness.—Dr. L. J. Harris and T. Moore: Hypervitaminosis.—M. G. Eggleton and P. Eggleton: A Method of Estimating Phosphagen and other Phosphorus Compounds in Voluntary Muscle.—W. J. N. Burch: A Synthesis of Hydroxyglutamic Acid.—W. J. N. Burch and Prof. R. H. A. Plimmer: Esters of Phosphoric Acid.—J. Lowndes and Prof. R. H. A. Plimmer: Bromination of Histidine.—Prof. R. H. A. Plimmer, W. H. Raymond, and J. Lowndes: Comparative Vitamin-B Values of Foodstuffs.—H. Allen, F. Dickens, E. C. Dodds, and F. C. Howitt: A Study of the Œstrus-producing Hormone with Special Reference to its Preparation and Standardisation in Water-soluble Form.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. C. O. Bannister: Some Examples of the Corrosion of Metals.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. H. W. Swift: Power Transmission by Belts: an Investigation of Fundamentals.

INSTITUTION OF LOCOMOTIVE ENGINEERS (North-Eastern Centre) (at Hotel Metropole, Leeds), at 7.—E. Windle: The Locomotive Smoke-box.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group, Informal Meeting), at 7.—T. H. B. Scott: British Cottage Homes.

GLASGOW DYERS' SOCIETY (at 7 Gordon Street, Glasgow), at 7.15.—Dr. S. G. Barker: Some Scientific Aspects of Wool as they affect the Wearer.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. H. Croucher: Some Applications of Time and Remote Control Switches.

TEXTILE INSTITUTE (Lancashire Section) (jointly with Blackburn Textile Society) (at Technical College, Blackburn), at 7.30.—A. Munro: Art, Textile Decoration, and Commerce.

ROYAL SOCIETY OF MEDICINE (Obstetrics Section), at 8.—Dr. J. D. Barris and Dr. W. Shaw: Rhabdomyosarcoma of the Ovaries.—Prof. A. Donald and Prof. F. Shaw: Age Incidence in Carcinoma of the Body of the Uterus.—Dr. J. Young: The Prognosis and Treatment of Late Pregnancy Toxæmia.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. R. H. Pickard: The Aims of Recent Research at the Shirley Institute.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at Grosvenor Restaurant, Gordon Street, Glasgow).—The "James Watt" Lecture.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Sir William B. Hardy: Short Range Forces.

SATURDAY, NOVEMBER 17.

BRITISH MYCOLOGICAL SOCIETY (London Meeting) (in Botanical Department, University College), at 11 A.M.—Dr. B. Barnes: The Production of Variations in *Botrytis cinerea* by Heating the Spores.—Dr. W. R. I. Cook: A New *Sorosphaera*.—R. Paulson: The Interpretation of the Microscopic Images of the Gonidium in *Xanthoria parietina*.—Miss Wakefield and W. Buddin: The Fungus causing Carnation Leaf Rot.—S. P. Wiltshire: A Stemphylium Saltant of an Alternaria.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. G. Whittaker: North Country Folk Music (I.).

BRITISH ASSOCIATION OF CHEMISTS (Annual General Meeting) (at Birmingham), at 7.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—P. A. Russell: Shrinkage Holes in Small Grey Iron Castings.

MONDAY, NOVEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section—London), at 6.30.—G. R. Bamber: Automatic Combustion Control of Furnaces.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Loughborough College), at 7.—C. K. Speid: Servo Equipment.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in Liverpool University), at 7.—Prof. G. E. Scholes: Combustion.

INSTITUTE OF CHEMISTRY (Leeds Area Section) (Annual Meeting) (at Great Northern Hotel, Leeds), at 7.15.—L. Staniforth: The Costing of Chemical Manufacturing Processes.

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—Dr. E. C. Wadlow: The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—H. B. Booth: British Wools.

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—H. R. Hirst: Textile Defects.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Sir Arthur J. Evans: The Palace of Knossos in the Light of Recent Reconstitutions.

ROYAL SOCIETY OF ARTS, at 8.—Dr. F. Kidd: Biology and Refrigeration (Cantor Lectures) (II.).

CHEMICAL INDUSTRY CLUB, at 8.—F. E. Hamer: The Recent Visit to America.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Miss G. Caton-Thompson and Miss E. W. Gardner: Recent Work on the Problem of Lake Moeris.

TUESDAY, NOVEMBER 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Diamonds (I.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—A. W. Flux: The National Income (Inaugural Presidential Address).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—J. R. Norman: The South American Characid Fishes of the Subfamily Serrasalmoninæ, with a Revision of the Genus *Serrasalmus* Lacépède.—Eleanor M. Brown: On a New Species of Microcotyle (Trematoda) from *Pagellus centrodontus*.—

H. B. Cott: Report on the Zoological Society's Expedition to the Zambesi, 1927.—Dr. C. L. Boulenger and W. V. Flower: The Regent's Park Medusa *Craspedacusta sowerbii*, and its Identity with *C.* (*Microhydra*) *ryderi*.—Prof. W. J. Dakin and Marion A. Hamilton: Notes on a naturally occurring Abnormality in the Domestic Fowl, associated with Enlarged Suprarenal Glands.—W. Kew: On the External Features of the Development of the Pseudoscorpiones: with Observations on the Ecdysis and Notes on the Immature Forms.—Oldfield Thomas: On Mammals from the Kaoko-Veld, S.W. Africa, obtained during Captain Shortridge's Fifth Percy Sladen and Kaffrarian Museum Expedition.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. W. E. Dalby: Mechanical Properties of British Rail-Steels.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associates' and Graduates' Branch, Manchester and District) (at Manchester), at 7.—W. Gregg: Fabric Drying.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. H. Lulham: The Spirit of Beauty in Nature and Art.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Cafe, Coventry), at 7.15.—L. H. Dawtrey: Automobile Brakes.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering Club, Wolverhampton), at 7.30.—Dr. E. C. Wadlow: The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—H. Bull and L. Johnson: The Welding of Stainless Materials.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—A. L. Armstrong: Report on Excavations in the Pin Hole Cave, Cresswell, and the Recent Discovery of an Engraving of a Masked Human Figure.

WEDNESDAY, NOVEMBER 21.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. F. J. W. Whipple: On the Association of the Diurnal Variation of Electric Potential Gradient in Fine Weather with the Distribution of Thunderstorms over the Globe.—N. K. Johnson: Atmospheric Oscillations shown by the Microbarograph.—H. Jameson: On the Mean Maximum Rain falling in a Time *t*.

EUGENICS SOCIETY (at Royal Society), at 5.15.—Dr. F. C. S. Schiller: Eugenical Reform of the House of Lords.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—F. G. Shotton: The Geology of the Country around Kenilworth (Warwickshire).—Dr. Stanley Smith and Prof. S. H. Reynolds: The Carboniferous Section at Cattybrook, near Bristol.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at Iron and Steel Institute), at 5.30.—E. Wyndham Hulme: Statistical History of the Iron Trade, A.D. 1717–1765.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—H. G. Cousins: Address.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—C. W. Salt: Address.

ALCHEMISTS' SOCIETY (in Chemistry Lecture Theatre, University of Glasgow), at 7.30.—Prof. J. Read: The Chemical Interest of Essential Oils: Some Research Experiences.

BURNLEY TEXTILE SOCIETY (at Oddfellows' Central Club, Burnley), at 7.30.—J. W. Pennington: Drawing and Twisting.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College), at 7.30.—B. P. Hill: Impressions of some Canadian and American Industries.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre) (at Royal Victorial Hotel, Sheffield), at 7.30.—W. D. Sheers: Electric Trams *v.* Motor Buses.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—Miss Kathleen M. Carter: Ovule Development and Meiosis in *Orobanche minor*.—Dr. W. H. Van Seters: Tripod and Pillar Microscopes.

ROYAL SOCIETY OF ARTS, at 8.—Sir Gerald Bellhouse: Safety in Factories.

FOLK-LORE SOCIETY (at University College), at 8.—S. G. Roberts: Tamil Proverbs in the Folk Stories of the late Natēsa Sāstri, M.F.L.S.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—S. Field: Presidential Address.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—A. J. Croft: Steel Works.

THURSDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. D. Adrian: The Mechanism of the Nerves (I.).

INSTITUTION OF CIVIL ENGINERES (Birmingham and District Association) (at Chamber of Commerce, Birmingham), at 6.—R. C. Moon: Notes on a Storm Water Pumping Plant.

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with British Institute of Radiology), at 6.—L. G. H. Sarsfield: The Electrical Equipment of X-Ray Apparatus.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Major T. M. Barlow: Weight of Aircraft.

INSTITUTION OF STRUCTURAL ENGINEERS, at 6.30.—Recent Improvements in the Strength and Constructive Value of Portland Cement.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (Annual Meeting) (at Essex Hall, Strand), at 8.—Dr. Marie Stopes: Details from 10,000 Birth Control Cases (Presidential Address).

MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.), at 8.30.—Dr. L. A. Weatherly: Juvenile Psychologic Delinquencies—their Origin and Treatment.

FRIDAY, NOVEMBER 23.

ANATOMICAL SOCIETY OF GREAT BRITAIN AND IRELAND (Annual Meeting) (in Anatomy Department, King's College), at 3.—J. H. Mulligan: Complete Absence of Corpus Callosum in Human Brain.—Prof. C. J. Patten: The Mechanism involved in the Technique of Bird Utterances.—Dr. A. B. Appleton: An Example of the M. Cervico-costo-humeralis (Gruber).—C. P. G. Wakeley: A Note on the Architecture of the Ilium.—Dr. R. J. Gladstone: The Origin of the Vena Azygos Major.—Dr. V. E. Negus: The Function of the Cartilage of Santorini.—Dr. F. W. R. Brambell: Histology of the Gonads of an Hermaphrodite Pig.—Dr. D. M. Blair: Note on Submaxillary Lymph Glands.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Dr. H. M. M. Mackay: Nutritional Anæmia in Infancy.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. G. Temple: The Physical Interpretation of Wave Mechanics.—A. Monkhouse: The Effect of Superimposed Magnetic Fields on Dielectric Losses and Electric Breakdown Strength.—A. Campbell: A New Potentiometer of Larson Type.—Prof. E. F. Herroun and Prof. E. Wilson: Ferromagnetic Ferric Oxide.—Demonstration by R. H. Humphrey of Emulsions showing Chromatic Effects.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. C. H. S. Evans: Searchlights and their Applications.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with Manchester Association of Engineers) (at Manchester), at 7.—R. Brooks: Electric Traction on Railways.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Tornblad and Mitchell: Hartmann Spiral Bricks.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—C. F. Moore: A Survey of Cadmium.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—R. Brooks: Electric Traction on Railways.

SATURDAY, NOVEMBER 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. G. Whittaker: North Country Folk Music (II.).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 16.

KING'S COLLEGE, at 8.—Prof. A. R. Ling: Contributions to the History of Starch and its Transformation Products (Streatfeild Memorial Lecture).

SATURDAY, NOVEMBER 17.

HORNIMAN MUSEUM (Forest Hill), at 3.30. H. N. Milligan: "Missing Links" and Evolution.

MONDAY, NOVEMBER 19.

UNIVERSITY OF LEEDS, at 5.15.—R. H. Fowler: Some Applications of the New Quantum Mechanics.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—J. B. Ormond: The Cultivation of the Cricket Bat Willow.

TUESDAY, NOVEMBER 20.

KING'S COLLEGE, at 5.30.—Miss H. D. Oakeley: Aristotle's Idea of Deity.

GRESHAM COLLEGE, at 6.—Sir Robert Armstrong-Jones: Physic. (Succeeding Lectures on Nov. 21, 22, and 23.)

UNIVERSITY OF LEEDS (in Philosophical Hall, Leeds), at 8.—Prof. A. C. Hardy: The Work of the R.R.S. *Discovery* in the Sub-Antarctic Regions.

WEDNESDAY, NOVEMBER 21.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Thomas Oliver: Lead Poisoning in Industries.

MEDICAL SOCIETY OF LONDON (11 Chandos Street, W.), at 5.15.—Dr. E. P. Cumberbatch: Physio-Therapy, with special reference to Medical Electricity (Chadwick Lecture).

KING'S COLLEGE, at 5.30.—Prof. E. V. Appleton: The Indebtedness of Industry to Pure Science: Electrical Communication and its Indebtedness to Physics.

UNIVERSITY COLLEGE, at 5.30.—W. C. B. Sayers: A Modern Public Library at Work.

THURSDAY, NOVEMBER 22.

GUILDHALL, BATH, at 8.—Dr. E. P. Cumberbatch: Physio-Therapy, with special reference to Medical Electricity (Chadwick Lecture).

UNIVERSITY COLLEGE, at 8.15.—Miss M. A. Murray: Art and Architecture of Ancient Egypt. (Succeeding Lectures on Nov. 29 and Dec. 6.)

FRIDAY, NOVEMBER 23.

KING'S COLLEGE, at 5.30.—C. J. Gadd: Assyrian Studies in the Past.

SATURDAY, NOVEMBER 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Mummies.

CONGRESS.

WEDNESDAY AND THURSDAY, NOVEMBER 21 AND 22.

INSTITUTE OF FUEL (at Institution of Electrical Engineers).

Wednesday, Nov. 21.

At 10 A.M.—Lord Melchett: Presidential Address.—Sir Henry Fowler: Fuel Conservation in Locomotive Practice.

In Afternoon.—Economics of Coal Production and Distribution:—G. Raw: Production.—Prof. H. Louis: Preparation.—Capt. R. Addy: Marketing.

Thursday, Nov. 22.

At 10 A.M.—Dr. F. Munzinger: Electric Power Stations.—Dr. E. S. Grumell: The Chemical Industry.—A. J. Dale and A. T. Green: Ceramic Industry.—Dr. Geoffrey Martin: The Cement Industry.—T. A. Peebles: American Practice and Experience.—J. R. Edwards: Practical Results of Fuel Control.

In Afternoon.—M. J. Conway: Liquid Fuel in Open-hearth Practice.—J. L. Bentley: Fuel Control in Open-hearth Practice.—H. C. Armstrong: Fuel Control in Reheating Furnaces.—J. B. Fortune: Fuel Control in Blast-furnace Stoves.

SATURDAY, NOVEMBER 24, 1928.

CONTENTS.

A Threat to Zululand Game Reserves.

A CONTROVERSY of some moment in the history of game preservation in South Africa has been raging in interested circles and in the press of the Union. The heads of two of the State departments—the Minister of Agriculture, General Kemp, and the Minister of Lands, Mr. Grobler—have decreed that two of the three game reserves in Zululand must be blotted out and their game exterminated. One of the threatened reserves is of particular interest, in that it harbours the last dwindling remnant of the southern race of the white rhinoceros, the largest of land animals next to the elephant.

Two considerations seem to have weighed with the ministers who have reached this fateful decision. In general, game reserves are unpopular with the farmers in their neighbourhood, since they restrict what has long been regarded as a legitimate source of sport and of food supply. The throwing open of a reserve is therefore an easy step to political popularity. A more specific plea is that since big game undoubtedly carries nagana, domestic stock runs a serious risk of infection from this source through the agency of tsetse flies. Upon this premise is founded the conclusion that the only method of freeing stock from nagana infection is the total extermination of big game throughout the area. This policy has long been favoured by General Kemp, and his present decision is consistent with his firm opinion.

It has still to be shown, however, that the policy of extermination is needful or even desirable from the stock-breeder's point of view. Indeed, many competent observers hold that extermination of big game but aggravates the trouble so far as domestic animals are concerned. In the first place, it is impossible to bring about the total extermination of all wild carriers of nagana, which the policy demands if it is to be effective ; in the second place, it is believed that the segregation of game in reserves tends to keep the tsetse fly restricted to definite areas ; in the third place, as was recently pointed out in an article in the *Journal of the Society for the Preservation of the Fauna of the Empire*, experience has shown that the slaughter of big game has caused the tsetse to range farther into new territories, and has not succeeded, and cannot succeed, in reducing the numbers of tsetse. On the other hand, satisfactory and unobjectionable methods of extirpating the tsetse fly and reducing the incidence of nagana in domestic stock are known, as has been shown

by experiments carried out in Southern Rhodesia, where the bush itself, the winter retreat of the tsetse fly, has been attacked.

In view of these facts, the decision to exterminate the game in the Zululand reserves appears to be premature. Fortunately, the decree of the Ministers of Agriculture and of Lands requires endorsement by Parliament and by the Natal administration before it can become effective. The necessary delay has given Dr. Leonard Gill, the Director of the South African Museum in Cape Town, an opportunity of voicing in the *Cape Times* a strong and reasoned protest against the abolition of the sanctuaries, and a leading article in the same journal, supporting his views, shows how great pride is taken in the unique heritage which South Africa retains in her wild animals, and how needful for her own credit in the eyes of a Nature-loving world is the preservation of the remnant of a fauna which has already suffered much at the hands of civilised man.

The controversy still continues. We can only hope that by expressing the enlightened will of the people it will succeed in turning aside the danger which threatens the Zululand reserves.

Rhodesian Man.

British Museum (Natural History). Rhodesian Man and Associated Remains. By William Plane Pycraft, G. Elliot Smith, Macleod Yearsley, J. Thornton Carter, Reginald A. Smith, A. Tindell Hopwood, Dorothea M. A. Bate, and W. E. Swinton. With an Introduction by Dr. F. A. Bather. Pp. xiii + 76 + 5 plates. (London: British Museum (Natural History), 1928.) 12*s.* 6*d.*

THE official account of the Rhodesian skull has now been published, and it will doubtless be read with interest by anthropologists all over the world. In his introduction, Dr. F. A. Bather, until lately head of the geological department of the Natural History Museum at South Kensington, reviews the somewhat contradictory records of the finding of the skull in 1921, and thinks that the evidence shows that, when it was found, the entire skeleton was with it, covered by a stalagmitic deposit; but that the greater part of the skeleton has since been destroyed, and that now it is quite uncertain whether any, and, if any, which of the human bones preserved, belonged to the skull. Since parts of at least three individuals are said to have been found, this is a most important admission.

A description of the skull and other human remains from Broken Hill, by Mr. Pycraft, Assistant Keeper in the Department of Zoology at the Museum, follows, and is greatly helped by a series of plates showing beautiful photographs of the skull from five points of view, as well as of some of the other bones. These probably are by far the most valuable part of the whole publication, and would have been more valuable still had they been full size instead of approximately three-quarters. If this were impracticable, a scale, photographed beside them, would have shown the reader what he should understand by 'approximate.'

To a craniologist it is clear that, before it was photographed, the skull was carefully orientated on the Frankfurt plane, though this is not stated: and it will be noticed that in taking the norma verticalis the vertex was tilted a little to the left. These, however, are comparatively trivial criticisms of some very fine and artistic reproductions.

Mr. Pycraft's description is painstaking and directs attention to many points which otherwise might be missed. It is well that the Museum authorities should have sought the help of a member of their zoological staff, because he is able to make many useful comparisons with the skulls of anthropoids, and his opinion that the Rhodesian skull is definitely human is valuable.

At the same time, in giving Mr. Pycraft the sole responsibility for writing an official account of this important skull, an account which may really be helpful to anatomists and physical anthropologists in other lands who have no opportunity of checking it with the remains, we cannot help thinking that the authorities have put him in a rather false position, through no fault of his own.

No one who has not worked in a dissecting room, as well as in a museum, can be expected to understand how largely the skull and bones are moulded by the muscles, ligaments, and nervous structures in relation with them; and though it is true that Mr. Pycraft writes familiarly about the semispinalis capitis and the rectus capitis posticus major, his deductions from them are quite unconvincing to an anatomist, especially since he fails to notice the influence which huge muscles like the trapezius and sternocleido mastoid have exerted.

On p. 7 we are told that "the foramen spinosum is not present," but on p. 27 we find "the sphenoid being produced beyond and behind the foramen ovale into the usual outstanding foramen spinosum." Owing to the ponderous style which is used, it is often difficult to know what the author really means; for example, he tells us that "the apertura

pyriformis is of the orygmoscrapid type," but this and the dissertation which follows fail to make clear whether the nasal opening has a subnasal fossa or not. Indeed, the whole description is so loaded with rarely used technical terms and turgid sentences about unessential things, that it would be difficult for an ordinary anthropologist to grasp were it not for the excellent photographs.

All this no doubt would have been pointed out and put right had Mr. Pycraft been granted the help of a colleague trained in human anatomy; nor should we emphasise them here were it not that we are dealing with the official account of our national museum, which will be accepted by our colleagues abroad as the best that British anthropology can do. It must clearly be understood that for this description of Rhodesian man, with the exception of the endocranial casts, British anatomists can claim no praise or share any blame.

Then, again, in considering the affinities of the skull, Mr. Pycraft admits, as every physical anthropologist who has seen it admits, its close likeness to the Neanderthal group, yet he seldom compares it carefully with other skulls of this series, but usually with Bantu, Australian, and modern English skulls; and this, we cannot help feeling, is a regrettable omission.

When we come to the description of the axial and appendicular skeletons, we find Mr. Pycraft more in need of expert help than ever. First he produces a sacrum which he says he is justified in regarding as a part of the skeleton which furnished the skull, because "its salient features agree completely with the evidence furnished by the hip girdle and limb." We may take it, therefore, that he sees nothing in it, as a sacrum, to associate it directly with the skull: certainly an anatomist would be surprised to learn that the weight of so massive a skull was transmitted to the pelvis by so slight a bone.

It is in the os innominatum, however, that Mr. Pycraft seems to have made his saddest mistake, because upon it he bases such extraordinary conclusions. He says that the portion of it upon which he has to work includes the acetabulum and the greater part of the great sciatic notch. Clearly this implies that he thinks that the greater part of the acetabulum is there, and that after he has reconstructed the small amount of the cavity which, according to him, is missing, Rhodesian man must have had a hip socket which truly was fearfully and wonderfully made. Then, with the deductive reasoning of a Sherlock Holmes, he points out that with such an extraordinary acetabulum, the patient must have had an extraordinary gait, an ape-like gait, with which he shuffled along, his thighs abducted and externally rotated, and his knees flexed.

Thus Mr. Pycraft leads us, step by step, to his culminating point, where he proposes a new genus, to be called *Cyphanthropus*, for Rhodesian man; and this he tells those of us who are less well versed in the classics than he, means 'stooping man.'

It seems that the whole of this rather dramatic climax would never have been reached had not Mr. Pycraft made rather a serious mistake in his osteology. The fragment of the os innominatum which he figures would serve quite well for that of a modern man if only he could realise that, instead of having nearly the whole of the acetabulum present, there is only a small segment of the upper part of it; a segment which gives us no reason to believe that the rest of the cavity was not perfectly normal in position and shape. There is therefore no reason for saying that the owner stooped, and the name *Cyphanthropus*, instead of being a label, becomes a libel.

One is glad that the writer tells us that "when the pelvis is orientated as in life with the body erect, the anterior inferior spine of the ilium is over the middle of the upper segment of the horseshoe-shaped acetabular border." No first year's anatomy student would make such a blunder, and Mr. Pycraft would be more than astonished if he could see the effect of such an orientation on a living body trying to stand upright. One is glad, because it is a touch of local colour which enables us to see the pelvis with his eyes and, seeing, to understand what a curious mental picture of the human form he must have.

Even if Mr. Pycraft could show that his anatomy is irreproachable, his observation accurate, and his judgment sound, we still would submit that he has not justified the harsh sentence which he has passed upon *Homo Rhodesiensis*. Is this poor man to be branded as *Cyphanthropus* for all time because his head was found in the same cave as some limb bones which may or may not have belonged to him, and which Mr. Pycraft thinks have stooping tendencies? The creator of this new genus thinks that he is quite justified because, he says, "when the outstanding features of these several parts are critically studied it will be found that they display a reciprocal inter-relationship so intimate that any attempt to dissociate the skull from the remaining parts of the skeleton must do violence to all ordinary rules of evidence and inference."

Since we are not favoured with these reciprocal inter-relationships which are so intimate, we must take it that we have been told all that is good for us, and must gratefully accept Mr. Pycraft's dictum as dogma where anatomy is concerned; but we may be allowed to wonder what "critically examined" means to him, and whether he has not already done violence to the ordinary rules of evidence and inference.

The endocranial casts, by Prof. Elliot Smith; the pathology of the left temporal bone, by Mr. Macleod Yearsley; the teeth, by Mr. J. Thornton Carter; the mammalian remains found with the skull, by Mr. T. A. Hopwood; and the stone implements, by Mr. Reginald Smith, form short articles which follow that of Mr. Pycraft. They all are written by able experts and are of considerable interest and importance. F. G. PARSONS.

Starch.

A Comprehensive Survey of Starch Chemistry. Vol. I. Compiled and edited by Robert P. Walton, in collaboration with the following authorities: Jerome Alexander, Carl L. Alsberg, Victor G. Bloede, Frederick D. Farrow, Auguste Fernbach, Herbert C. Gore, Sir James C. Irvine, Johann R. Katz, Arthur R. Ling, George M. Moffett, Walter A. Nivling, Amé Pictet, Eugen Preuss, Hans Pringsheim, Max Samec, Henry C. Sherman, Jokichi Takamine, Jr., T. Clinton Taylor, Harold G. Turley, Leo Wallerstein. Pp. 360. (New York: The Chemical Catalog Co., Inc., 1928.) 10 dollars.

AS specialisation in all subjects develops, there can be little doubt that the text-book of the future will consist of a series of short monographs by experts forming a symposium of the various phases of the subject. In this instance the single material starch requires eighteen such monographs, occupying 240 pages, to cover its chemistry and technology, and the remarkable bibliography which follows requires a further 330 pages.

Mr. Walton has been unusually fortunate in his collaborators—Pictet, Irvine, Ling, and Pringsheim are the four recognised leaders of the ranks of those who are endeavouring to elucidate the structure of starch. Fernbach and Sherman on the fermentation side, and the several writers on the technical side, are all names which inspire respect. There is evidence of careful editing, and one is struck at the outset with the absence of superfluous matter and the desire to make each section crisp, suggestive, and yet complete.

The structure and nature of starch is still the subject of lively discussion, and to the student the conflicting theories are necessarily somewhat confusing. According to Pictet, by distillation under reduced pressure, starch gives at least 30 per cent of lævoglucosan, a double anhydride of established constitution. Decomposition by heat in the presence of glycerine gives in turn hexahexosan, trihexosan, and α-glucosan, which is a double anhydride of known but different structure. There is thus evidence of both α- and β-linkages either in starch itself or formed during its degradation. Starch is regarded as a polymerisation product of a hexosan. Irvine, in discussing the evidence afforded by the methylation of starch, retains in the formula of maltose a furane ring structure for the second glucose unit, though it is not that generally accepted at the moment. He postulates an anhydrohexaglucose containing 6 side-chain hydroxyl groups as the starch nucleus, though he recognises the objections against so large a ring system. Ling considers starch to contain, as basal unit, hexa-amylose, which on hydrolysis yields a trisaccharide, β-glucosido maltose, from which by enzyme hydrolysis either maltose or isomaltose is obtained. Isomaltose still remains the elusive 'criminal' of starch chemistry—all attempts to isolate and to define its structure have failed, and there is reason for believing that its structure is so closely akin to maltose that it may be regarded as a labile form.

Pringsheim, who has obtained a series of amyloses by the bacterial degradation of starch, contributes a highly technical and valuable discussion. The polyamyloses are made up of hexosans which contain glucosidic residues. In the transition from hexosans to polyamyloses one of these is replaced by another, the constitution of which is yet unknown, and must be responsible for the tendency towards aggregation.

A new phase in starch chemistry is the recognition that amylopectin is a dibasic organophosphoric acid—this theme is developed by Samec in an interesting essay.

Hitherto, in bread-making, attention has almost entirely been directed to the protein and mineral constituents of flour, but Alsberg, in a suggestive treatise, is able to show that starch does play a rôle, even though a minor one, and acts as more than mere inert material. The manufacture of corn starch as an American and of potato starch as a German industry are clearly summarised, also the less known manufactures of dextrin and starch gums, starch and flour adhesives, all industries of increasing importance to-day.

Attention is also devoted to the use of starch for

sizing in the textile industry and to the application of enzymes for removing starch again. The conversion of starch in the fermentation industries receives adequate treatment by the experienced hand of Fernbach.

Enough has been said to indicate the range of the work; it remains to emphasise the suggestive and critical spirit which is so prominent. This makes it highly stimulating and it should be of the greatest value to workers in the many corners of this vast field. The bibliography demands a special word. It purposes to record all periodical literature, from 1811–1925 inclusive, dealing with the chemistry and technology of starches, their degradation products and enzymes. The references are arranged chronologically under classified heads involving 46 classifications. In many cases references are also given to English, French, and German abstracts of the original article, and, further, a brief indication of the contents of the paper is given.

The compilation is an altogether remarkable one, and though the labour of preparing it must have been very great, the time saved by future workers in this field should provide a perennial flow of thanks to Mr. Walton outweighing all material consideration.

E. F. ARMSTRONG.

A Great Indian Monarch.

Asoka (*Gaekwad Lectures*). By Prof. Radhakumud Mookerji. Pp. xiv + 273 + 16 plates. (London: Macmillan and Co., Ltd., 1928.) 21*s*. net.

TWO topics from India's past history seem to exercise a paramount influence on the minds of her modern scholars. One of them is the problem, or series of problems, connected with the Compendium of Politics by Kautilya, which was unearthed from a South Indian manuscript about twenty years ago by the late Mahāmahopādhyāya Ganapati Shastri. The other is the history of the great King Ashoka as it can be reconstructed from his inscriptions and from later, and to a great degree legendary, sources. On both subjects a vast lot of energy and learning has been spent in recent years—unfortunately, with results which do not stand in proper relation to the strenuous efforts made in achieving them.

Prof. Radhakumud Mookerji, whose name is well known through his history of Indian shipping and other learned works, has now entered the ranks of Ashokan investigators with an imposing volume of nearly three hundred pages. This work, we are informed in the preface, has grown out of the author's Gaekwad Lectures delivered to the University of Lucknow; and it does honour alike to its author and the enlightened Prince and Government who have financed these lectures and their publication. We feel inclined to disagree with Prof. Mookerji on more than one point, and should give expression to our doubts were this to be a review of scientific details. As it is not, we shall abstain from criticising minor points; and we shall content ourselves with saying that the author's learning, industry, and enthusiasm in his work are at any rate beyond criticism.

Ashoka stands out as the most clearly individual and undoubtedly the most noble of ancient Hindu rulers. It seems fairly obvious that, from a nationalistic point of view, Prof. Devadatta Bhandarkar should consider him to be far superior to men like Alexander, Cæsar, and Napoleon, though his reasons for propounding such views are wholly unhistorical. It also seems easily explicable that Ashoka's own countrymen should consider him to be one of the greatest of men—which possibly he also was. But that 'possibly' has to be somewhat strongly emphasised; for, after all, we know little enough of the man, and that little is simply what he himself has told us.

The later Buddhist sources tell us that in his younger years Ashoka was a loathsome tyrant who put all his brothers to death and invented a special sort of 'hell' where people were subjected to the most fiendish tortures. But there can scarcely be any doubt that these sources are wholly legendary. The glory of that faith preached by the Enlightened One would shine forth still more splendidly if it were able to convert this human fiend into a *jagadguru*, a parent of all living creatures. The inscriptions certainly afford us no reasons for believing such tales; the pious king, instead of telling us something about his previous cruelties, somewhat strongly opposes his own reign of righteousness to the less resplendent virtues of former rulers. Apparently, according to his opinion, *dharma*—which ought rather to be translated by 'compassion towards living beings'—had made its real entry into a brutish and sinful world with the beginning of his reign.

However, there was one fact that sorely troubled the saintly monarch even after he had started upon his conquest by righteousness. That fact was the conquest of Kalinga, which had been perpetrated eight years after his coronation. At that time hundreds of thousands had been slain and carried off into captivity; and our knowledge of the ruthless slaughter that had often been practised in Indian warfare does not lead us to think this to

be an exaggeration. This endless misery, however, led Ashoka to contemplate other triumphs, namely, those to be won in spiritual warfare; and not only amongst his own subjects did he practise compassion and liberality and inculcate the rules of morality, but also he claims to have done this among the Greeks and Kambojas in the immediate borderlands, and even in the realms of the Seleucids, the Ptolemies, and other Greek rulers. It need scarcely be said that such a claim involves some slight exaggeration.

Prof. Mookerji describes to us Ashoka as he himself—and many other scholars besides—has conceived him from a careful study of the existing edicts. He presents us with what scanty notices we possess concerning the great ruler's early life and family, concerning his history and administration. To some length he dwells on his religion and the monuments which, in his pious zeal, he dedicated to the memory of Gautama Buddha and to the service and protection of his followers; and then more than half of the book is taken up by a careful translation, with copious notes, of the edicts. The work winds up with a good and careful index. Altogether a useful book which reflects credit upon its learned author.

The picture of Ashoka given us here is the traditional one; nor could we well expect anything else. But the real historical problem still remains to be solved, and will perhaps never reach a satisfactory solution. That problem, of course, is this: who was the real Ashoka, the one seen by his contemporaries and beloved or loathed by them? We know the names of his father and grandfather, also the name of his family; but whether that family was of noble breed or base-born we know not. We know the approximate length of his reign, and we cannot go far wrong in our calculations of his exact regnal dates. But of the man himself we know nothing more than that which his own edicts tell us; no contemporary of his has left us even a line to give a corroborative or different shading to the picture drawn by himself. Was he then—as we all would fain believe, and evidently have very strong reasons for believing—a saintly, pious, self-sacrificing man who looked upon all living beings as his children? Or was he—which to Indian minds will perhaps sound even sacrilegious—a sanctimonious hypocrite who preached every virtue to his co-fellows while leading a life of vice and cruelty? The possibility is there, but happily only a very faint one; and we need scarcely be afraid of losing faith in Ashoka, one of the everlasting glories of the land of the Hindus.

Our Bookshelf.

Penrose's Annual: the Process Year Book and Review of the Graphic Arts. Edited by William Gamble. Vol. 31. Pp. xvi + 184 + 72 + 74 plates. (London: Percy Lund, Humphries and Co., Ltd., 1929.) 8*s.* net.

THIS Annual is on the same lines as heretofore, and certainly maintains its reputation of recording by word and by examples the present possibilities of printing in its many branches. The present is the thirty-first issue; its growth is indicated by the fact that whereas the first issue had 66 pages of text and 20 pages in colour half-tone, the present volume has 184 pages of text and 44 colour pages.

The first article is "The Editor's Review" of the year's progress. He tells us that though inventors have been at work at pictorial telegraphy for half a century, it is only during the past year that it has made the final strides that have brought it into daily use in the service of illustrated journalism.

A specimen from the Prismatone Company of Chicago shows the possibility of combining in one printing in four colours, artistic and commercial subjects, and also text matter, printing on both sides of the web without heat for drying the inks at a speed of four thousand cylinder impressions per hour. Rotary photogravure for one colour and also for three-colour printing from thin copper plates affixed to the cylinders, instead of using the surface of the cylinders themselves, is now a practical success. The coating of copper printing surfaces with a thin film of chromium is now in actual use, and its advantages, due chiefly to its hardness, are recognised. Specimens of colour prints and fine half-tones by the Blackmore Tintex Process, show excellent results on cheap newspaper, and point to the possibility of getting rid of the coarse screens generally used for this purpose.

The book includes many interesting articles on subjects not often dealt with in print, such as "Paper old and new," transparent paper (with photomicrographs), fancy paper (with examples), gummed paper—its varieties and their uses—each by a separate authority. Mr. Vernon Booth, the printer and printing instructor at St. Christopher School, Letchworth, advocates teaching children to cut printing blocks in linoleum, to help them to express their ideas.

Industrial Catalysis. By Stanley J. Green. Pp. xi + 507. (London: Ernest Benn, Ltd., 1928.) 50*s.* net.

SINCE each forward movement supplies a new resource to aid the next advance, progress in science and in those industries founded on it is taking place at an ever-increasing rate. In no instance is this statement better exemplified than in the highly specialised field of catalysis and the many industries which are based on its application. The author of the work before us records first the discovery of the scientific facts; he then seeks to

show how they have been utilised or applied, and emphasises the consequences. To some extent the title chosen by him is misleading, as the book contains no account of the working of any actual processes in which the principles of catalysis are applied, nor does it provide any clue as to which of rival processes have stood the test of economic success: it is essentially a theoretical treatise, though exceedingly full and thorough in its consideration of the considerable scientific and patent literature of the subject.

After a brief survey of the history of catalysis, a longer chapter is devoted to the consideration of the phenomena, followed by an explanation of such physico-chemical theory as is required and a discussion of the theories of catalysis. These sections will be found of considerable value by the initiated, though, for ourselves, we find the wood to be rather full of trees and could wish the author had given us a clearer lead as to the path to follow. He sums up that only the intermediate compound theory and the adsorption hypothesis amongst the numerous suggestions of the past have stood the test of time, and rightly emphasises that the two theories possess one fundamental idea in common, namely, that the catalyst first associates itself chemically with one of the reacting substances, forming an intermediate complex—either a true chemical compound or a surface combination—which is more reactive than the initial substance. The further explanation of the progress of the reaction is the problem which awaits solution; of much interest, therefore, is the suggestion of Lewis that the specific energy conferred by the catalyst is in the nature of radiant energy of definite frequency.

The consideration of the great mass of detail is divided into chapters headed respectively oxidation and combustion, nitric acid, hydrogen and hydrogenation, ammonia, dehydrogenation, dehydration, and lastly the utilisation of coal. Mention of this last subject is sufficient to show how wide the ramifications of catalysis are about to become; undoubtedly the many workers in this field will derive useful hints from Mr. Green. E. F. A.

Science and Reality. By R. A. Sampson. (Benn's Sixpenny Library, No. 37.) Pp. 80. (London: Ernest Benn, Ltd., 1928.) 6*d*.

THE Astronomer Royal for Scotland has written an admirable essay on the general character of scientific knowledge. The argument, though much condensed and avoiding no difficulties, should be intelligible to any normal person who is prepared to apply his mind seriously to the matter. No special scientific or philosophical knowledge is assumed. It is to be hoped that the book will be widely read, as it is well designed to correct popular fallacies about science.

The author considers first the most abstract kind of science, taking geometry as his example, and then goes on to deal with more concrete types, taking first of all astronomy. The secret of the success of scientific method, and of its limitations, is found in the process of abstraction and definition; the distinction and separation of elements in experience, which can then be put together again. The method is often arbitrary and always involves unproved assumptions, but it is impersonal and cumulative; cumulative because impersonal. For this very reason science can never supply more than partial knowledge. "We are familiar with the fact that as a practical guide, theory is always dangerously incomplete. Its method is first to remove the life from any phenomenon before discussing it. Out of Nature's bounty of wild flowers it collects laboriously for its own reference a sort of *hortus siccus*."

One word of adverse criticism seems to be called for. The bibliography consists entirely of important and first-rate works, except for the first item. As that is the only work dealing primarily with the philosophy of science, it is a pity it should be an inferior one, when there are so many good books available on the subject, for example, those of Poincaré and Russell.

Culture and Social Progress. By Prof. Joseph Kirk Folsom. (Longmans' Social Science Series.) Pp. x + 558. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 12*s*. 6*d*. net.

TEN years after the cessation of hostilities we are able to regard culture in as favourable an aspect as it deserves, being freed, as it now is, from the distasteful significance which it acquired with the advent, and during the continuance, of the War. This discursus by Prof. Folsom, dealing with "Culture and Social Progress," is one which presents the subject attractively; it is lucid in treatment, deft in arguments, dispassionate in conclusions, and for the most part convincing. The author submits that the true keynote of culture is personal liberty. He heads the chapter dealing with the elimination of waste with some words by Charles P. Steinmetz: "Work is a curse. The chief aim of Society should be to abolish work." His own arguments seem to support this unhealthy view: "Labour, by and large, is disagreeable, but its unpleasantness is mostly of that mild sort we call boredom," is merely one of the author's remarks in that direction. It is indisputable that waste is, in general, to be deprecated and avoided, but it may be confidently asserted that a world without work would be a world with no outlook. With the above as the main, and perhaps the sole, protest, it may be said that the book merits cordial approbation. P. L. M.

Tychonis Brahe Dani Opera Omnia. Edidit I. L. E. Dreyer. Tomus IX. Pp. viii + 352. Tomus XIV. Pp. iv + 327. (Hauniæ: Libraria Gyldendaliana, 1927, 1928.)

THESE two volumes, which have seen the light after the editor's death, would appear to complete his great edition of the works of Tycho Brahe, apart from an *index rerum*, which it would seem is still awaiting publication. Of these two volumes, Tomus IX. has been edited almost entirely by the late Dr. Dreyer's colleague, Dr. Ræder. Tomus

XIV. appears to have been edited almost entirely by Dr. Dreyer himself.

The two volumes are, on the whole, of more personal than scientific interest. The first 146 pages of Tomus IX. are occupied by meteorological observations in Danish extending from 1582 to 1597. Following this is a draft preface to an astrological and meteorological annual by a pupil. Then come a few pages written as a preface to Tycho Brahe's reply to Craig on comets. Next, after three brief medical treatises, comes a collection of Tycho's poetry, so far as it has not already appeared in earlier volumes. A compilation of various readings in the works contained in the first nine volumes, a Danish glossary, an index of names occurring in the meteorological observations, and addenda and corrigenda to the nine volumes complete this volume.

Tomus XIV. is wholly taken up by letters and documents in many languages bearing on the life of Tycho Brahe. Many of these are by Tycho Brahe himself. Their interest lies almost entirely in their value as biographical material. The volume closes with a genealogical table showing Tycho Brahe's nearest relatives and descendants.

J. K. F.

Die Entstehung und Besiedelung der Koralleninseln: nach neuen Gesichtspunkten auf Grund eigener Untersuchung. Von Prof. Dr. Augustin Krämer. Pp. viii + 53 + 4 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1927.) 5 gold marks.

PROF. A. KRÄMER, an honorary professor of Tübingen and naval doctor, has returned from thirty years' wanderings in the South Pacific Islands, deeply interested in their welfare. He deplores for the sake of the inhabitants the view that the coral islands have an unstable basis, and are being slowly diminished by submergence. He accordingly describes Darwin's theory as "cheerless," and also rejects the view that the islands have been submerged by a rise of sea-level. He adopts the Chamisso-Murray theory, and holds that the foundations are stable and that the islands grow by the accumulation of limestone debris formed by the surf. Darwin's belief in a submerged central Pacific continent, the so-called Hawaiki, he rejects, as regards diluvial time, as being as improbable as Atlantis or Gondwanaland. That this continent should have lasted so late is unnecessary for Darwin's theory, and its dismemberment by submergence probably happened in the late Oligocene or Miocene. In spite of Dr. Krämer's knowledge of the Pacific coral islands and the new information he contributes regarding them, his explanation of their formation without submergence is unconvincing.

Assimilation and Petrogenesis: Separation of Ores from Magmas. By John Stansfield. Pp. 197 + 30 plates. (Urbana, Ill.: Valley Publishing Co 1928.) 3.50 dollars.

THE question of the extent to which rocks have been made and modified by assimilation of extraneous material and ores have been formed by consolidation from molten rock, has been long discussed, and the possibilities shown by many experiments. Prof. Stansfield of Illinois has conducted an instructive series of experiments, and melted more than 550 mixtures of rock materials. His results support the view that assimilation may be an important factor, but do not confirm many suggestions such as the formation of the nepheline-syenites by the assimilation of limestone.

The extent to which assimilation has acted in Nature must be determined by the field evidence. In these experiments the materials were ground very finely, mechanically mixed, and fused at temperatures from 1230° to 1600° C. Under those conditions assimilation was more likely than under natural conditions. In the experiments on ore materials, some of the metallic sulphides were found to move upward instead of downward, as was expected from the theory that some ores are due to the settlement of the heavier constituents in the base of a molten mass.

The book is clearly and concisely written, and illustrated by 60 excellent photographs of the artificially formed rocks.

World-Radio" Map of European Broadcasting Stations in relation to the British Isles. Prepared for the British Broadcasting Corporation under the advice of Rear-Admiral H. P. Douglas. Scale: 100 Statute Miles to 1 Inch. 38 in. × 28½ in., mounted on linen, folded. (London: British Broadcasting Corporation, 1928.) 3*s*.

THE British Broadcasting Corporation has issued a 'world-radio' map of Europe. The map is so constructed that the distances and the bearings of all continental stations can be found at once from it. Straight lines drawn from any point in the British Isles to continental stations can be regarded as representing great circles on the earth's surface, and the distances along them are on the scale of 100 miles to the inch. It is constructed on the 'zenithal' system, the centre of the map being near Manchester and Birmingham. Short-wave stations are marked differently from long- and medium-wave stations. It is interesting to notice that Sweden and Finland are plentifully dotted with broadcasting stations and that there are very few in Italy. To every one who possesses a sensitive receiving set and is interested in listening-in to distant continental stations the map will be of great value.

Pyroxylin Enamels and Lacquers: their Raw Materials, Manufacture, and Application. By Dr. Samuel P. Wilson. Second edition, enlarged. Pp. xv + 253. (London: Constable and Co., Ltd., 1928.) 18*s*. net.

THE subject of pyroxylin enamels is becoming increasingly important, and a revised edition of Dr. Wilson's book will be welcomed by those who are interested in this field. The information is essentially practical, and the raw materials include many which have recently come into use. The treatment of the subject is authoritative, and the book is a valuable contribution to the information required by the practical man.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Influence of Steam and of Hydrogen on the Burning of Carbon Monoxide.

IN connexion with the different views that have been expressed concerning the relative influence of steam and of hydrogen on the burning of carbon monoxide-air mixtures, may I point out that this influence may be shown in different ways according to the phenomena under observation and the conditions: for example, the rate of pressure rise in a bomb explosion, the temperature of initial ignition, the speed of the flame either in the slow uniform movement or in the explosion wave.

I think all workers are agreed that the rate of the explosion wave in carbon monoxide knall-gas under ordinary pressure is increased as steam is added to the mixture until between 5 and 6 per cent is present; and that a similar percentage gives the fastest uniform slow movement in carbon monoxide-air mixtures. On the other hand, Prof. Bone has found that in a bomb at high initial pressure, the rate of spread of the flame (as indicated by the rate of rise of pressure) increases rapidly on the addition of traces of steam, but reaches a maximum when less than 1 per cent of steam is present. The initial high pressure appears to favour the direct oxidation of carbon monoxide in the flame.

With regard to the effect of hydrogen added to the mixture, Prof. Bone and his colleagues find that the flame in the high-pressure bomb travels more rapidly with 1 per cent of hydrogen than with 1 per cent of steam; and therefore regard as heresy a phrase they quote from a paper by Payman and Wheeler that "moisture is more effective than hydrogen in promoting the combustion of carbon monoxide." Now some years ago it was shown in our laboratory that the explosion wave in carbon monoxide knall-gas was slightly faster with 1 per cent of hydrogen than with 1 per cent of steam (*J.C.S.*; 1923); and in the same year the experiments at Sheffield showed that in order to get a uniform flame in carbon monoxide-air mixtures of maximum speed, 6 per cent of steam was necessary, whereas only 3 per cent of hydrogen was required to produce the same effect. It was not, I take it, the *rates* of the flame, but the difficulty of *starting* the flame in the mouth of the tube containing the dry mixture, when less than about 2 per cent of hydrogen was present (a difficulty not found with a mixture containing much less than 2 per cent of moisture), that led to the words quoted, which had, by the way, the prefix "apparently."

I have recently been experimenting on the effect of hydrogen and steam on the ignition point of carbon monoxide in air by sending a small stream of carbon monoxide (with and without hydrogen) into an atmosphere containing known volumes of steam, both gas and atmosphere being pre-heated before they come in contact. The ignition temperatures so found are largely influenced by the pressure of the atmosphere, and the effect is different in the two cases. When hydrogen is added to the carbon monoxide and the air is dried, the ignition points fall regularly as the pressure is reduced from 1000 mm. down to 200 mm.; whereas when the carbon monoxide is dry, and steam is added to the air, the ignition points *increase* as the pressure is reduced from 1000 mm. to 600 mm. and then decrease. It happens, therefore, that carbon monoxide containing 1 per cent hydrogen may ignite in dry air either above or below the temperature at which carbon monoxide ignites in air containing 1 per cent of steam. It depends on the pressure.

At the other end of the scale, an unexpected result was found here in 1923, namely, that an explosion wave travelling through electrolytic gas when it impinges on carbon monoxide knall-gas (with either steam or hydrogen present) is damped down and loses its 'detonation' character, which it recovers only after an appreciable 'run.' This still wants explaining.

Prof. Bone, in his recent important work on high-pressure explosions, has now given us a new problem. He finds a marked acceleration in the pressure-rise when the hydrogen content exceeds 0·65 per cent in a carbon monoxide-air mixture fired at 50 atmospheres and at room temperature, when the explosion has the character of a detonation; but this sudden rise is not observed when the bomb, filled with the same charge, is heated before firing to 100°, the initial pressure being 64·4 atmospheres.

Again, the study of the radiation of carbon monoxide flames in Prof. Garner's laboratory has shown the marked effect of hydrogen in lowering the radiation while it accelerates the rate of the flame: and here also there appears to be a sudden change, giving a step-like curve, as if two different mechanisms were at work.

It was an active hare that was started in that Oxford laboratory fifty years ago.

H. B. DIXON.
University, Manchester.

The Quantum Theory of Nuclear Disintegration.

IN a very interesting letter published in NATURE of Sept. 22, p. 439, Gurney and Condon have used wave mechanics to give a qualitative explanation of many features of natural α-ray disintegration. It may be of interest to point out that using very similar assumptions, it is possible to give a quantitative explanation of these features and also to throw light on the phenomenon of artificial disintegration. I should therefore be glad to be permitted to give a short account of these investigations here.

In the model of the nucleus adopted (G. Gamow, *Zs. f. Phys.*, Bd. 51, p. 204) the region of the inverse square law forces extends inwards, without serious perturbations, to a critical distance r_0 which is appreciably less than the closest distance of approach of the α-particles, calculated on classical mechanics, for which inverse square law scattering at large angles is still observed. For distances less than r_0 there exist attractive forces which vary very quickly with the distance. An α-particle of suitable energy can stay inside the nucleus for long periods of time, periods which on the classical theory would be infinite, since the α-particle could never pass over the potential barrier. On the wave picture, on the other hand, no such barrier can ever completely prevent a gradual leaking out of the waves, representing the process of escape of α-particles.

The theory enables one to express the radioactive decay constant, λ, in terms of the velocity of the α-particle and the atomic number Z of the element. The approximate solution of the problem (G. Gamow u. F. Houtermans, *Zs. f. Phys.* in course of publication) gives the quantitative theory of the Geiger-Nuttall relation, including the explanation of the main deviations from it. In Fig. 1 the observed values of the logarithm of the decay constant λ are plotted against the velocity of the emitted α-particle v_α and connected by a continuous line. The dotted line

connects the theoretical values of log λ, calculated on the assumption that the critical distance r_0, where the very rapid potential fall takes place, has the value $7 \cdot 4 \times 10^{-13}$ cm. for the whole family. An almost perfect fit can be obtained if r_0 is taken to vary as the cube root of Z. Such values of r_0 make the internal nuclear volume nearly proportional to the total number of α-particles contained in the nucleus, and if extrapolated to light elements fit well with the critical distance $3 \cdot 4 \times 10^{-13}$ cm. deduced by Bieler from the deviations from inverse square law scattering in aluminium.

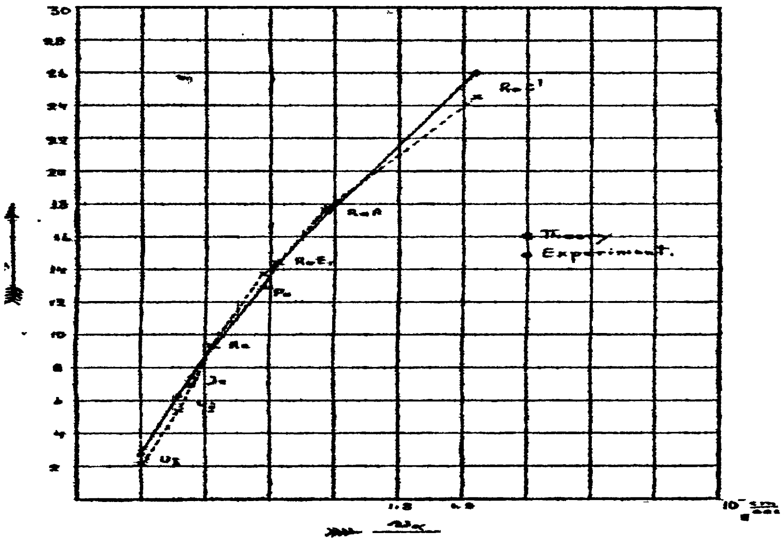

FIG. 1.

The same model of the nucleus allows us to calculate an upper limit to the probability of artificial disintegration by bombardment with α-rays, on the natural assumption that such disintegration is only possible if the incident α-particle enters the inner region of the nucleus (G. Gamow, *Zs. f. Phys.* in course of publication). We must again remember that on the wave picture the incident α-particle can penetrate the potential barrier even if its energy is less than the maximum opposing potential. We thus get a probability of penetration depending for a given element exponentially on the velocity of the incident particles and decreasing very rapidly with the atomic number of the element. These probabilities expressed in numbers of penetrations per cm. track in standard air per million incident α-particles are given in Fig. 2 as a function of the atomic number of the element bombarded; the full and dotted curves correspond to the initial velocities of α-particles from ThC′ and RaC′ respectively. In this calculation the critical distance r_0 is taken to have Bieler's value for aluminium. For light elements the difference between the opposing potential and the energy of the α-particle is small. The results therefore depend largely on the model adopted, as the largest atomic number for which classical penetration is possible can be estimated only approximately. The general shape of the curves will, however, remain the same, giving a very rapid decrease in the probability of artificial disintegration for heavier elements. Rutherford's observations for nitrogen and aluminium are shown by dots and circles for the two velocities.

Taking into account the approximate character of the calculations and the experimental uncertainties, the close agreement of the observed points with the curves may be taken to indicate that for these elements the ejection of a proton almost always follows immediately on the penetration of the α-particle into the central nuclear region. That no artificial disintegration was observed by Rutherford for certain other light elements is in no way contradictory to the theory, for it merely means that no proton is ejected even after penetration, and this is especially natural for the elements of atomic weight $4n$, where the nucleus in all probability is built up entirely of α-particles.

Such penetration without disruption of the nucleus can only result in the ejection of the α-particles approximately evenly distributed in all directions (induced radioactivity), and will probably be found to explain the remarkable increase of the scattering for large velocities of α-particles observed by Rutherford for the light elements. The remarkable feature of curves in Fig. 2 is the steepness of the fall to zero for larger atomic number (for example, for iron the probability of disintegration falls to 10^{-5} and for iodine to 10^{-16}). This is in most satisfactory agreement with Rutherford's observations, in which no artificial disintegration has been observed for any element heavier than phosphorus. On the other hand, it is quite impossible to bring the theory into agreement with the observations of Petterson and Kirsch, which not only show numbers of disintegration ten or more times as great as Rutherford's for light elements, but also show a considerable probability of disintegration for elements as heavy as iron.

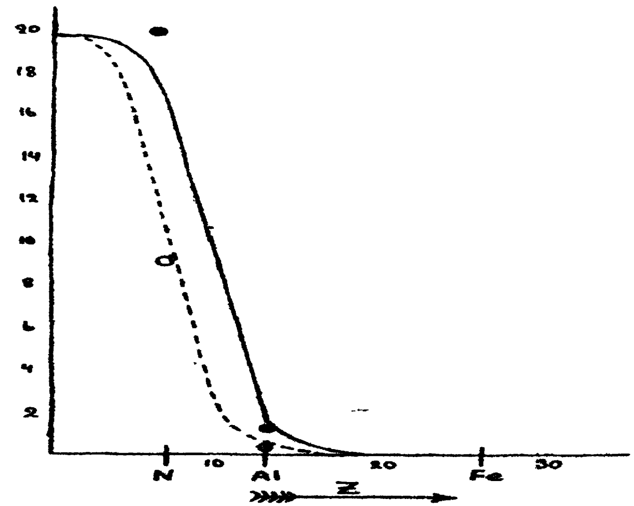

FIG. 2.

G. GAMOW.

Institute for Theoretical Physics,
Copenhagen, Sept. 29.

The Ultra-Violet Light of the Sun as the Origin of Auroræ and Magnetic Storms.

A THEORETICAL investigation has been made of the outlying regions of the atmosphere of the earth and of the effect of sunlight on these regions; certain of the conclusions are given in this preliminary note. By the usual methods the temperatures and the pressures of the atmosphere to great heights were calculated for a quiet sun, that is, the sun in its normal state, with no terrestrial auroræ or magnetic storms. Because of the unequal balance at cold temperatures between the solar energy absorbed in the ultra-violet by the atmospheric gases and the energy re-emitted in the infra-red by the gases, the daytime temperatures above 100 km. were found to increase with the height above the surface of the earth, until at 300 km. or 400 km. temperatures of 1000° Kelvin seem reasonable. (There is, of course, nothing novel in this, although we have been interested in working the matter out more exactly perhaps than has been done heretofore.)

At heights above 400 km. the atmosphere becomes very rare and the free paths of the particles very long—practically infinite, in fact, were it not for the actions of gravity and of sunlight. A portion of the atoms (or molecules) of these remote regions dance up and down, receiving upward thrusts from thermal impacts below and falling back under gravity, and may be expected to reach heights up to 10,000 km., but scarcely above this. During the daytime a number of the outlying atoms are excited by the short-wave ultra-violet light of the sun to which they are exposed. A normal atom upon collision with the excited atoms may receive a high velocity (collision of the second kind), a velocity sufficient perhaps to send it beyond the gravitational attraction of the earth. A normal atom may also attain a high velocity by absorbing the energy of recombination of a positive ion and an electron. Therefore there are a number of high-flying atoms in the outer reaches of the atmosphere, and these give rise to interesting effects. Many of them might leave the earth never to return were it not for the sunlight. They do hasten out towards interplanetary space, but under the photoelectric influence of the solar ultra-violet radiations they soon become ionised. Once ionised they are caught by the magnetic field of the earth, and as ion pairs are constrained to spiral around the line of magnetic force, eventually being brought back to the earth. If the line ends in sunlit latitudes, the ion may start off on another wild heavenward chase, or it may wander down to more prosaic lower levels. If the magnetic line ends in night latitudes, as in the polar regions after sun-down, the ion pairs, upon plunging to the lower levels, hand over their energy of recombination to the atmosphere of those regions. This energy may go into heat, or it may, if conditions are suitable, reappear as light, such as the auroral display. (In passing, we may note that a complete theory of the rate of escape of planetary atmospheres should contemplate the ideas of the foregoing paragraphs.)

Quantitative estimates indicate that an appreciable fraction of the solar ultra-violet energy is carried to a zone 20° to 30° from the magnetic poles by high-flying ion pairs ejected to heights of 20,000 to 40,000 km. above the earth. The estimates have depended upon a knowledge of such quantities as the intensity of sunlight in the extreme ultra-violet, the number of excited atoms, absorption coefficients (Einstein's B), etc. These quantities are imperfectly known, but, so far as can be seen, reasonable values have been used. For the case of a quiet sun, the amount of energy transferred to the auroral zones appears about sufficient to supply the energy of a mild auroral display. This is in keeping with the fact that the aurora occurs on a rough average two or three times a week throughout the year, with no very marked seasonal variations. From the velocities of ejection of the high-flying atoms and the time which elapses before they become ionised, it comes out that a majority of the ion pairs plunge to the earth in a zone roughly 20° to 30°, or 1400 to 2000 miles, from the magnetic poles, and that relatively few get down to regions within 1000 miles of the magnetic poles. This is in accord with the observed 23° zone of maximum auroral frequency. Since the auroral energy at a given magnetic meridian is regarded as being brought in from the sun-lit latitudes on roughly the same meridian, one would expect (as is observed) the aurora to be brighter (or to occur more often) in the early hours of the night than in the later hours. In brief, the main characteristics of the aurora receive logical explanation on the present theory.

When the sun becomes active, the magnetic effects of the high-flying ions, perhaps inappreciable during intervals of solar quiescence, become pronounced and result in the magnetic storms. We assume that the sun when active sends out a sudden blast of ultra-violet light. For example, if 1/10,000 part of the solar surface, which normally is at a temperature of 6000°, were removed and there were exposed the black body radiations from regions at a temperature of 30,000°, the total ultra-violet energy in the wave-lengths 500 to 1000 angstroms would be increased by 10^5, whereas the solar constant would be increased by only one per cent. Actually, in times of solar activity, variations of three or more per cent in the solar constant are observed, and the increase at $\lambda 3500$ angstroms is such as to suggest even higher temperatures than 30,000°. The number of the high-flying ions is then increased by, say, a factor of 10^5 over the number formed during undisturbed solar periods. The ions, no matter what their velocities are, under the combined action of gravity and the earth's magnetic field, move at right angles to these two vectors with a velocity approximately mg/He, the positive and negative ions moving in opposite directions. Thus there is an electric current around the earth, the lines of current flow being roughly circles in planes perpendicular to the magnetic axis of the earth, with centres on the axis. (Each cubic centimetre of the high atmosphere, of course, remains electrically neutral at all times in spite of the current flowing through it.) Calculation of the energies and processes involved, indicated that the blast of solar ultra-violet light produces enough high-flying ion pairs to give rise to a current of 10^6 amperes for an hour or so. This causes a magnetic field of the order of 10^{-3} gauss simultaneously over the whole earth, which is the order of magnitude observed in the first phase of the world-wide magnetic storms. It has long been realised that an equatorial current would account for the world-wide magnetic storms, and several hypotheses have been suggested as to the cause of the current. The hypotheses have, however, contained a number of difficulties which are absent from the present theory.

The high-flying ions descend in large numbers to the zones about 25° from the magnetic poles and form there diamagnetic concentrations of considerable intensity. On the assumption that the blast of ultra-violet light does not die away abruptly, but continues with lessening intensity for a day or so, the diamagnetic polar atmospheric concentrations wax with the day and wane with the night. Upon working out the changes in the earth's magnetic field caused by this diamagnetism, agreement is found in practically

every detail with the observed complicated diurnal storm variations in the three magnetic field components at all latitudes.

H. B. MARIS.
E. O. HULBURT.

Naval Research Laboratory,
Washington, D.C., U.S.A.,
Sept. 30.

The Understanding of Relativity.

I HAVE read with great interest the leading article on "The Understanding of Relativity," contributed by H. D. to NATURE of Nov. 3. I do not doubt Einstein's work. His conclusions have been tested crucially and found correct. But though I believe, I do not understand. I can only suppose, as H. D. indicates, that the expositors of Einstein have expressed themselves in language which does not convey to ordinary men the meanings they intend. For example, H. D. asks, "What is there difficult to understand in the statement that if we watch a man moving quickly we shall find that his clock will not keep time with ours?" But I do find it difficult. If our clocks are good, why will they not keep time? What has space to do with it? I can understand that his clock will not, in a sense, keep time with the sun; for if he starts at midday and travels with the sun, and as fast, he will always be at midday. But surely his clock will measure the passage of time with mine, tick by tick; and surely it is possible to explain in simple language that which H. D. finds so simple.

Another paradox which puzzled me before ever I heard of Einstein, and which to this day I do not understand, is that, while I am told that parallel lines are those which keep a certain distance apart—say a yard—I am also told that parallel lines, if continued far enough, will ultimately meet—owing to the curvature of space, or some such reason incomprehensible to me. But, if they always keep a yard apart, how can they meet? Is paradox necessary in science? So far as I am able to judge, paradox always means words used with unlike meanings. A horse-chestnut and a chestnut horse is an example.

I feel I am airing my ignorance; but this sort of ignorance is so widespread that its dispersal is worth while. Science, limited to "only three (or is it eleven?) people in the world," is very limited. For the mass of people it is dogma, that refuge of authority and that bane of science. Once again I ask, in what sense will the other man's watch not keep time with mine? Since H. D. declares in effect that it is not difficult to understand, he should find it easy to explain.

G. ARCHDALL REID.

20 Lennox Road South,
Southsea, Nov. 6.

SIR ARCHDALL REID'S inquiry, which is very much to the point, arises, I think, from an indefiniteness in the word 'understanding.' When applied to a scientific deduction outside present possibility of observation, this word has at least three distinct meanings. First there is the simple comprehension of what is predicted; secondly, the understanding of why it should be so, expressed in terms of more elementary scientific concepts; thirdly, the understanding of why scientific men have been led to predict it. To take an example—suppose the earth were permanently cloud-bound, and a physicist predicted that above the clouds space would appear blue. Understanding in the first sense would correspond to a clear mental picture of what was meant by the statement. In the second sense it would mean the mastery of the theory of the scattering of light. In the third sense it would mean the understanding of the reasons which led to the prediction, which might conceivably involve a knowledge of the behaviour of a photoelectric cell in a sounding balloon.

Of these three meanings, the one implied throughout the article in question was the first. It may seem the most trivial, but it is actually the most important for the non-scientific man, for it represents what is for him the most vital part of science; that part, namely, which he can assimilate and use in forming his own personal creed or philosophy. He can dispense with details of technical interest, but he cannot dispense with a knowledge of what it is that science is actually finding out. It is the provision of this kind of understanding that is the aim of expositors who employ the properties of curved mirrors to illustrate the requirements of the special theory of relativity or those of 'parallel' lines drawn on spheres to represent the effects of the curvature of space. The devices are admirable, and have been admirably utilised by more than one writer. So far as I know, it is not possible to improve on them, and students infinitely lower in scale of intelligence than Sir Archdall Reid can, by their aid, understand the requirements of relativity as well as they understand that the sky is blue. The reason why they question this, as I conceive it, I have stated in the article; it is simply scepticism.

I think this interpretation of the position is really borne out by Sir Archdall Reid's letter. He asks why the clocks of observers in quick relative motion will not keep time. This is asking for understanding of the second type, and I can only answer: I do not know; it is simply a fact of Nature too elementary to be explained in this sense. But the interesting thing is to consider why Sir Archdall Reid asks this question. He does not ask why two Admiralty chronometers, one at Greenwich and one at Chatham, should keep time. Although, presumably, he has not made the experiment, I take it he would not regard the result as beyond understanding. Yet it is on precisely the same footing as the relativity result. The facts that clocks at these two different places keep time, and that clocks in quick relative motion do not keep time, are equally elementary facts of conceivable observation. Why, then, 'seek for a sign' in one case and not in the other? I suggest that it is simply because the first confirms a preconception and is therefore credited, while the other violates a preconception and is therefore instinctively discredited. If Sir Archdall Reid really believed Einstein, why should he require an explanation from him and none from the Astronomer Royal?

H. D.

The Universe and Irreversibility.

ON the assumptions that space-time is finite spatially but not temporally (apart from supernatural events such as creation), and that atoms and radiation are mutually convertible, Sir James Jeans (NATURE, 122, p. 689; 1928) arrives at the conclusion that the universe is progressing towards a final state of maximum entropy from which no return is possible. While such a state has a maximum *a priori* probability, it does not follow that it is final.

Supposing the state of maximum entropy to be reached, and all atoms capable of such a transformation to be dissolved into radiation, Sir James Jeans (NATURE, 121, p. 674; 1928) calculates that the probability of existence of one non-permanent atom is of the order of $10^{-10^{11 \cdot 6}}$. In other words, during only $10^{-10^{11 \cdot 6}}$ of the rest of eternity will there be even one non-permanent atom. Now the minimum number of atoms in the present universe, according

to Hubble (*Astrophysical Journal*, 64, p. 321; 1926) is about 10^{81}. Then, as Sir James Jeans (NATURE, 121, p. 674; 1928) points out, the probability of a universe with as little entropy as it possesses at present is of the order of $(10^{-10^{11\cdot 6}})^{10^{81}}$, or $10^{-10^{92\cdot 6}}$, assuming that an appreciable fraction of the present atoms are non-permanent, and that most of the energy of the present universe is in the form of radiation of frequency too small to build atoms readily. This probability is very small, but finite, and remains finite however large the finite universe may be. Now in the course of eternity any event with a finite probability will occur. Hence if the present universe melts away into radiation, another equally improbable will develop in the course of about $10^{10^{100}}$ years. But the improbabilities involved are so vast that it is perhaps unlikely that even a single atom will be built up from radiation in inter-galactic space during the 'life' of the present universe. Fluctuation can generally be neglected in practical life, but not in the contemplation of eternity.

If the above argument is correct, there is no need to assume a break in the order of Nature to account for the beginning of the present universe. In this case the time taken by such events as the 'life' of a star is instantaneous in comparison with its re-creation; and eternity is, on the whole, dull. Indeed, all but $10^{-10^{100}}$ of it is duller than the present moment. But during most of eternity there can be no living creatures at all resembling ourselves to be bored. For since all organisms live by the utilisation of processes involving increase of entropy, they can presumably only exist during the aftermath of a very large fluctuation. This is why we are witnesses of this excessively unusual occurrence.

This letter is not intended to suggest that the above view of the universe is correct, but that it is consistent with Sir James Jeans's premisses, even if the actual numbers involved are very different from those here assumed.

J. B. S. HALDANE.

Sir William Dunn Institute,
University, Cambridge.

MAY a self-constituted Anubis of the scientific philosophy of 'the ancients' raise a plaint outside the door of the Temple of Modern Knowledge from which he hears the voice of its Secretary stating his opinion about their views? (Supp. NATURE, Nov. 3). The irreversibility of living energies was fundamental knowledge on which the ancient scientists of Aryavarta based their doctrines of evolution, human and cosmic; and the ancients will be pleased to know that the moderns have, in their turn, discovered this law of Nature. Everything in the universe, from atoms to stars, is subject to 'birth' (manifestation) and 'death' (withdrawal into latency). Periodical cycles of appearance and disappearance of all forms of life is the method of the evolution of *consciousness*. The phœnix rises out of the dead ashes at the close of the dark half (Pralaya) of the cycle. The ancients would agree with the view expressed in the notes on p. 703 referring to Sir James Jeans' lecture "that a degradation of the physical universe is not necessarily a degradation of the world of spirit." To them a *Manvantara* is a cycle of a solar system: a *Mahamanvantara* that of the cosmos. These cycles are "The days and nights of Brahmâ." Oxford has published "The Sacred Books of the East" in many volumes, but Cambridge is advised to read the English translations of Indian scholars, who understand better the technical language and scientific symbols of their ancestors.

W. W. L.

An Attempt to Polarise Electron Waves by Reflection.

AN experiment has been made to test whether or not electron waves are polarised by reflection from the face of a crystal.

The experiment is similar in method to the double mirror experiment by which one demonstrates the polarisation of light by reflection from glass. A homogeneous beam of electrons is reflected at 45° incidence from a {111}-face of a nickel crystal, and the reflected beam proceeding from the first crystal is then reflected at the same angle of incidence from a second similar crystal. A double Faraday box is placed to receive electrons proceeding from the second crystal in the direction of regular reflection, but only such electrons are allowed to enter the collector as have retained all or nearly all of their initial energy through the two reflections. Electrons which have lost amounts of energy corresponding to more than two equivalent volts are excluded by an opposing potential.

The second crystal and the collector are joined rigidly together, and the system comprising these parts may be rotated about an axis which coincides with the axis of the beam proceeding from the first to the second crystal. It is possible, therefore, to vary the dihedral angle between the plane of incidence of the second reflection and that of the first. There are two positions of the moveable system for which these planes coincide, and for these 'parallel' positions the current entering the collector should be a maximum provided asymmetry is impressed upon the electron beam at reflection; for the intermediate 'transverse' positions the current should be a minimum.

The observation is that, if such a doubly periodic variation of the current with angle exists, its amplitude is less than two one-hundredths of the total current, which corresponds to the uncertainty of the measurements. So far as our observations go, there is no polarisation of electron waves by reflection.

The measurements have been made at bombarding potentials in the range 10 to 150 volts. Within this range the intensity of the doubly reflected beam exhibits five maxima, occurring at bombarding potentials 20, 55, 77, 103, and 120 volts. The maxima corresponding to the highest three of these voltages were observed in our earlier experiments on electron reflection (*Proc. Nat. Acad. Sci.*, 14, 624 (Fig. 3); 1928). The two at the lower voltages were outside the range of these previous observations.

The beam at 120 volts is particularly strong, and with regard to this beam it may be stated that the amplitude of the variation due to polarisation is less than one-hundredth of the total current.

The current incident upon the first crystal is about 2×10^{-4} amp., and the current received in the collector is of the order 5×10^{-12} amp.

C. J. DAVISSON.
L. H. GERMER.

Bell Telephone Laboratories, Inc.,
New York, N.Y., Oct. 19.

Radiovision.

IN steering clear of the hybrid 'television' in a note in NATURE of Nov. 3, p. 704, you lead to a confusion of terms which, unfortunately, is common.

'Radiovision' is suitable for 'television' by radio, but 'television' can also be transmitted by telegraph or telephone line.

Near the end of the note you refer to "the radio pictures," meaning 'television.' The broadcast of radio pictures—phototelegraphy—is now being done by the B.B.C., and is in a state much nearer practicability than 'television.'

In several countries there is great controversy over the use of terms in this new branch of applied science. It is almost certain that these words will remain: television, in English-speaking countries; télévision in France; and fernsehen, in Germany. It would be well for the sake of preventing misunderstanding if the philological quibbles were dropped immediately.

WILLIAM J. BRITTAIN.

Lake Drive, Hull.

MR. BRITTAIN raises the question of what is meant by radiovision and television. As a rule, we have to be guided largely not only by the context but also by the nationality of the user. At one time it was thought that radio-telegraphy should replace wireless telegraphy, and many committee meetings were held by electrical engineers to consider this question. It was found that commercial interests, including patent rights, had to be considered, and so as a compromise the British Engineering Standards Association agreed to sanction both. As a matter of fact it has become common practice to use both, and the question of the survival of the fittest may never arise. In America, 'radiovision' is largely used to denote the transmission of living pictures partly through the ether, and an attempt is made to restrict television to the transmission of living pictures through wires. Phototelegraphy is another art altogether. It is the reproduction of photographs, pictures, etc., by electric impulses sent through wires or through the ether. The Post Office and the Marconi Company make extensive commercial use of this method, and we have seen admirable reproductions of photographs made in a few minutes sent from Berlin to London. Perhaps it would be best to use the hybrid word 'television' to denote the art of sending practically instantaneous living pictures over long distances either by wire or by the ether and restrict the hybrid word 'radiovision' to the latter method of transmission. The use of words like 'televisor,' which is a trade word registered by the Baird Company, to denote a special kind of apparatus, is obviously restricted.—[EDITOR, NATURE.]

Stellar Spectra in the Far Ultra-Violet.

STELLAR spectra cannot be studied in the far ultra-violet spectral region, because the earth's atmosphere has too strong an absorption beyond about 3000 A., due to the amount of ozone in the upper atmosphere. There is no doubt that this ozone is formed by the photochemical action of the sun's radiation. Most of this ozone is at a height of 45-50 km., although the measurements of Dobson and his co-workers show that perhaps about 30 per cent of this ozone diffuses to deeper layers, probably to 20 km. or lower. On the other hand, we can suppose that in the higher layers (100 km. and more) less ozone will be formed, corresponding to the lower pressure.

If we consider that in the midwinter in a polar region of about 4000 km. diameter the sun's radiation does not penetrate deeper than to a height of 50 km. at the edge of this circle, and not deeper than to about 700 km. over the north pole, we should expect that at this time no ozone will be formed there. We should also expect that the ozone formed during the summer will be decomposed before midwinter. Then we should not find a strong absorption of ultra-violet light in this arctic region in the midwinter unless convection were to move ozone from southern regions to this polar zone. But under favourable conditions we can also expect that a large amount of ozone will be decomposed before it reaches the place of observation. It is not probable that the endothermic ozone can be driven 4000 km. or more from the place of photochemical formation to the place of observation without any decomposition.

Therefore at a place in the polar region near the edge of the arctic night we should find a better chance of observing shorter wave-lengths in stellar spectra than at any other time and any other place. With only a small percentage of the normal amount of ozone, we should find the whole spectrum to about 2100 A., where the absorption of the oxygen molecule begins. What the real conditions are we do not know, but in any case we can expect with certainty from a study of stellar ultra-violet spectra in the arctic night just as important results for astrophysics as for meteorology and geophysics.

This paper was communicated by Prof. H. N. Russell at the meeting of the International Astronomical Union in Leyden to Prof. S. Rosseland and Prof. C. Störmer (Oslo). They expect to arrange experiments to study this problem at Tromsö.

GUNTHER CARIO.
(Fellow of the International Education Board.)

Palmer Physical Laboratory,
Princeton, N.J.

The Structure of the Benzene Ring.

AN X-ray examination of hexa-methyl benzene, $C_6(CH_3)_6$, recently completed, has led to certain definite and fundamental conclusions concerning the symmetry and form of the benzene ring.

The crystals belong to the triclinic system and there is only one molecule in the unit cell. The maximum molecular symmetry is therefore a centre, in agreement with previous results on benzene and the fully halogenated benzene derivatives (E. Gordon Cox, NATURE, 122, 401, and others). One of the possible minimum cells, however, has its a and b axes very nearly equal (9·010 A. and 8·926 A. respectively), while the angle between them is 119° 34′, that is, nearly $2\pi/3$. There is an excellent cleavage parallel to the (001) plane, and the reflections from the various orders of this plane diminish in intensity in almost the same proportion as those from the (001) cleavage plane of graphite. There is also a marked *periodicity* in the intensities of reflection from planes in the [001] zone. The reflections from ($h\ k\ 0$) planes correspond closely to those from ($k\ \overline{h+k}\ 0$) and ($\overline{h+k}\ h\ 0$) planes. There is a similar, though less obvious, resemblance between ($h\ k\ l$) ($k\ \overline{h+k}\ l$) and ($\overline{h+k}\ h\ l$) planes.

These intensity variations prove quite clearly the existence (hitherto assumed for crystallographic purposes) of pseudo-hexagonal or hexagonal symmetry in the benzene ring, and also that, in this compound at least, the benzene ring is almost if not quite *flat*; that is, it resembles the rings of six carbon atoms existing in graphite rather than those in diamond.

A further analysis of the intensities shows that the only possible arrangement of carbon atoms is one in which the side of the benzene hexagon (distance between centres of neighbouring carbon atoms) is 1·42–1·48 A. The least C—C distance in graphite is 1·42 A., while the side of the hexagon obtained by *projecting* Bragg's 'puckered' benzene ring on to the mean plane of the ring is 1·45 A. The substitution, therefore, of a flat benzene ring for the puckered rings in naphthalene and anthracene would not affect the periodicity in the c direction, which is one of the most striking features of those crystals (W. H. Bragg, *Zeit. f. Krist.*, **66**, 27).

A more detailed account of this investigation is now being prepared and will be published elsewhere.

K. LONSDALE (*née* YARDLEY).

The University, Leeds.

The Palæozoic Mountain Systems of Europe and America.[1]

By E. B. BAILEY.

TWO factors are involved in the geological classification of folded mountains, namely, date and position. One-half of the surface of Europe has escaped mountain deformation since the dawn of the Cambrian. This area, which we may call Baltica, has its base on the Urals and its apex in South Wales.

Two Palæozoic mountain chains meet in South Wales about the western angle of Baltica. In 1887 Suess named the older of them Caledonian, out of compliment to Scotland. It runs north-east and its folded, cleaved, and broken rocks appear at the surface in many parts of the British Isles, in most of Norway and along much of the Swedish frontier. They frequently include marine representatives of the Cambrian, Ordovician, and Silurian; but the Devonian, where developed within the Caledonian belt of Britain and Scandinavia, and often in adjacent districts, is of continental or, in other words, of Old Red Sandstone facies; and is later than the more violent of the mountain disturbances.

Near Girvan we find, in addition to the post-Silurian unconformity, another of intra-Ordovician date, sufficiently important to bring Upper Llandeilo conglomerates on to Arenig plutonic intrusions. This earlier unconformity disappears with amazing rapidity towards the south-east; but north-westwards it increases in scope, while in the same direction the post-Silurian unconformity fails.

The evidence for these propositions lies partly in the Southern Uplands and partly in exposures to the north-west. The interpretation of the Southern Uplands is one of the miracles of science. We owe it to Lapworth, an English schoolmaster attracted to Galashiels by the charm of Scott's romances. During the seventies of last century Lapworth demonstrated that the hitherto despised graptolites furnish an extraordinarily sensitive time-scale for Ordovician and Silurian stratigraphy. This led him on to the discovery that many of the rock groups that pass with broken complication through the tightly compressed steep isoclinal folding of the district change profoundly in thickness and character from south-east to north-west.

The total thickness of the Upper Llandeilo, Caradoc, and Llandovery at Moffat in the centre of the Southern Uplands is given by Peach and Horne as 220 feet, consisting of black graptolitic shale and unfossiliferous mudstone. At Girvan, which is only 25 miles to the north-west in cross-strike measurement, these same formations are reckoned as more than 4800 feet thick, and their constituents include conspicuous conglomerates, grits, flags, grey shales, shelly beds, and one 60-foot limestone, in addition to subordinate intercalations of black graptolitic shales. The coarse deposits mark an approach to a coast line lying to the north-west, and their material contains much recognisable debris of Arenig cherts, lavas, and intrusions that must have formed part of a land surface in that direction. The great thickness of such shallow-water marine sediments indicates long-continued subsidence of the sea bottom, preparatory, as it were, to mountain upheaval.

The most impressive geological phenomenon in Scandinavia is the marginal over-riding of Baltica by the Caledonian mountains. It is best displayed in the province of Jämtland, where there are comparatively wide exposures of fossiliferous Cambrian, Ordovician, and Silurian. These formations lie undisturbed in the south-eastern part of their outcrop. Gradually, north-westwards, tranquillity is replaced by isoclinal folding, small-scale thrusting, and intense distributed shearing. Above lies the great Scandinavian thrust-mass or 'nappe,' the cause and origin of all the trouble.

When, in 1888, Törnebohm first propounded his overthrust theory of the Scandinavian Chain, he mentioned sixty miles as a minimum displacement, and compared this estimate with the half-mile of overthrusting previously described by himself from Dalsland and with Peach and Horne's ten miles from the North-west Highlands of Scotland. In 1896, by which time he had received important help from Högbom, he was able to demonstrate that the Scandinavian thrusting exceeds eighty miles.

The North-west Highlands of Scotland show the opposite margin of the Caledonian Chain to that studied by Törnebohm in Jämtland. A British audience knows full well the history of discovery in this wonderful region. Peach and Horne's lucid and beautifully illustrated descriptions, dating from 1884, 1888, and 1907, have, in Suess's words, "rendered our northern mountains transparent." The fossiliferous sediments of Durness, over which the Moine crystalline schists are thrust, are of Cambrian and probably Lower Ordovician age. They are essentially a quartzite-limestone (largely dolomite) succession, and in lithological character and fossil content they belong much more nearly to North America than to the rest of Britain.

The Atlantic seaboard of North America, southwards from Newfoundland, is constituted of Palæozoic mountains, locally concealed beneath a coastal spread of Cretaceous and Tertiary rocks. American geologists call their ancient mountains the Appalachian System. To European eyes they appear as a complex of two systems, rather than as a single system; but for the moment we may let this pass. Beyond the Appalachian Mountains lies an enormous interior region, the Laurentia of Suess, which, like Baltica, has remained unaffected by folding since late pre-Cambrian days.

The age and relations of the portion of the Appalachian complex, which borders the St. Lawrence Lowlands of Laurentia, justifies our grouping it with the Caledonian System. It was Marcel Bertrand who, in 1887, saw that the Appalachian Mountains, as a whole, could be partitioned among the two great Palæozoic systems that, on our side of the water, meet in South

[1] From the presidential address to Section C (Geology) of the British Association, delivered at Glasgow on Sept. 10.

Wales. In Newfoundland, Canada, and northern New England the Appalachian Mountains belong to the Caledonian System, in the sense that their main movements were completed before the close of the Devonian period.

On Dec. 31, 1860, Logan addressed a long letter to Barrande, and told him how he had been forced to recognise a zone, situated on the mountain front, where older rocks are habitually overthrust upon younger. He actually laid down the course of his postulated thrust all along its Canadian outcrop from Lake Champlain to the extremity of Gaspé. On this account the Champlain—St. Lawrence thrust-zone is often spoken of as the Logan Line.

Logan was of course only applying a familiar principle; for, in the States, thrusts had been described by the brothers Rogers so early as 1842, and, in the Alps, by Escher in 1841. Still, there can be no question that Logan's letter to Barrande furnishes one of the main landmarks of tectonic science.

Logan also recognised that the north-westward frontal thrusting of the Caledonian Mountains of Canada followed a much older line of slope, leading down south-eastwards from the platform of Laurentia to the comparative depths of the Caledonian sea bottom. He gave his theoretical slope a double function. First of all it had to act as a boundary to early sedimentation, and then as a guide to later thrusting and folding. There is, however, another aspect of Logan's Slope that has not, I think, attracted sufficient attention. This slope, when completely submerged, seems to have furnished a dividing line between clear-water Ordovician limestones (American facies), that grew on its top to the north-west, and muds and sands (Caledonian facies) that, creeping from the opposite direction, came to rest at its foot. The fossils of the two sets of deposits are as distinct as the rocks themselves, and this has led certain distinguished palæontologists to postulate continuous land barriers, or isthmuses, separating the two fields of accumulation. On the other hand, I think it can be established that the limestone of the one field has repeatedly landslipped down upon the mud of the other; in which case the division cannot have been an isthmus, but merely a submarine slope.

My conception of the Logan Slope is a slight modification of Logan's original. Let us picture the slope, not as a rigid feature of pre-Cambrian date, eventually obliterated by Palæozoic sedimentation, but as tectonic in origin and intermittently renewed by hinged subsidence. Earthquakes connected with the intermittent renewal were probably responsible for the landslips to which I have just alluded. It is well known that most of the major earthquakes of to-day originate on submarine slopes, and that important submarine landslips precipitated by such earthquakes have been described, for example, in connexion with the Tokyo disaster of 1923. Of late years Kendall has reawakened British students to the possibility of recognising earthquake phenomena in the records of the past. I believe that a story of recurrent earthquakes is written in the submarine landslip-deposits of the Logan Slope.

If now we cast our minds back to the change of facies that Lapworth recognised in the Southern Uplands of Scotland, we find it on the whole of more gradual type than that characteristic of Canada. In the Southern Upland sea, mechanical sediment travelled down a tectonic slope, and change of facies depended upon the arrest of coarse material

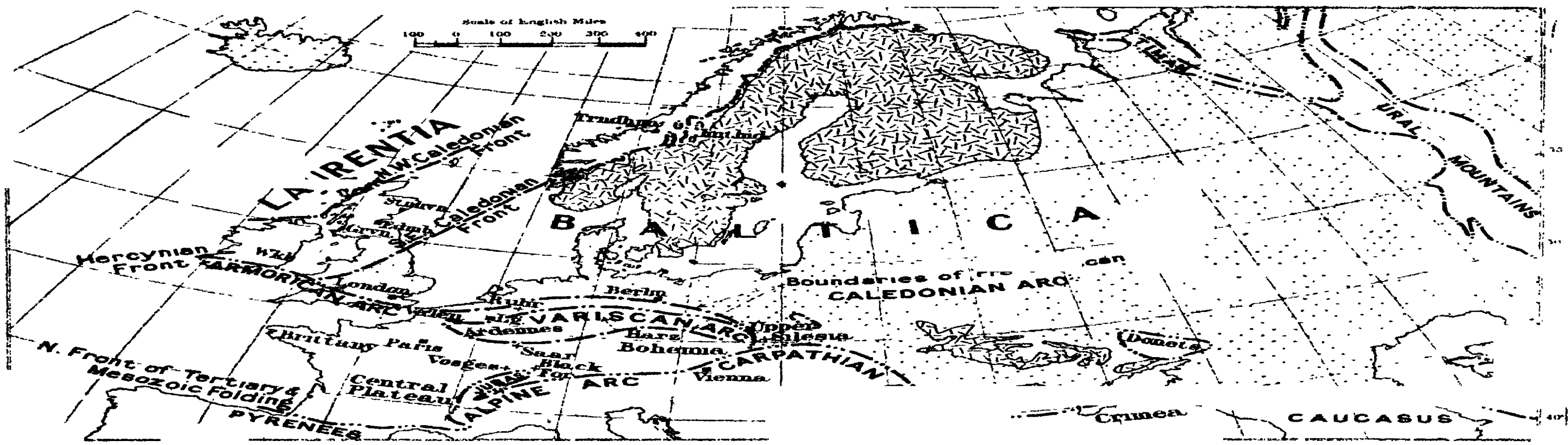

FIG. 1.—Tectonic map of Europe. The ornamented regions (Baltica, Laurentia, etc.) have remained unaffected by mountain-folding since pre-Cambrian times. Their pre-Cambrian outcrops are shown by ticks, Cambrian and later by stipple. Contractions are used for Black Forest, Edinburgh, Girvan, Jämtland, Liège, Stonehaven, Trondhjem, Valenciennes, Wicklow.

by deep water. In the Canadian sea, mechanical sediment reached the foot of a tectonic slope up which it was unable to climb. In both cases we notice subsidence preceding mountain elevation—an idea which had its beginnings in a publication of Hall's on the Appalachians, dated 1859, and its subsequent development more especially in the writings of Dana and Haug.

In 1887, the later of the two great Palæozoic chains that meet in South Wales received a double name from Suess. He distinguished along its course a couple of congruent mountain arcs with an inflectional junction of their fronts (syntaxis) near Valenciennes on the Franco-Belgian border. The eastern arc he called Variscan, the western Armorican. The names are based on the Latin for the Bavarian town of Hof, *Curia Variscorum*, and for the French province of Brittany, *Armorica*. The meeting of the two arcs near Valenciennes is closely comparable with the meeting of the Carpathians and Alps near Vienna.

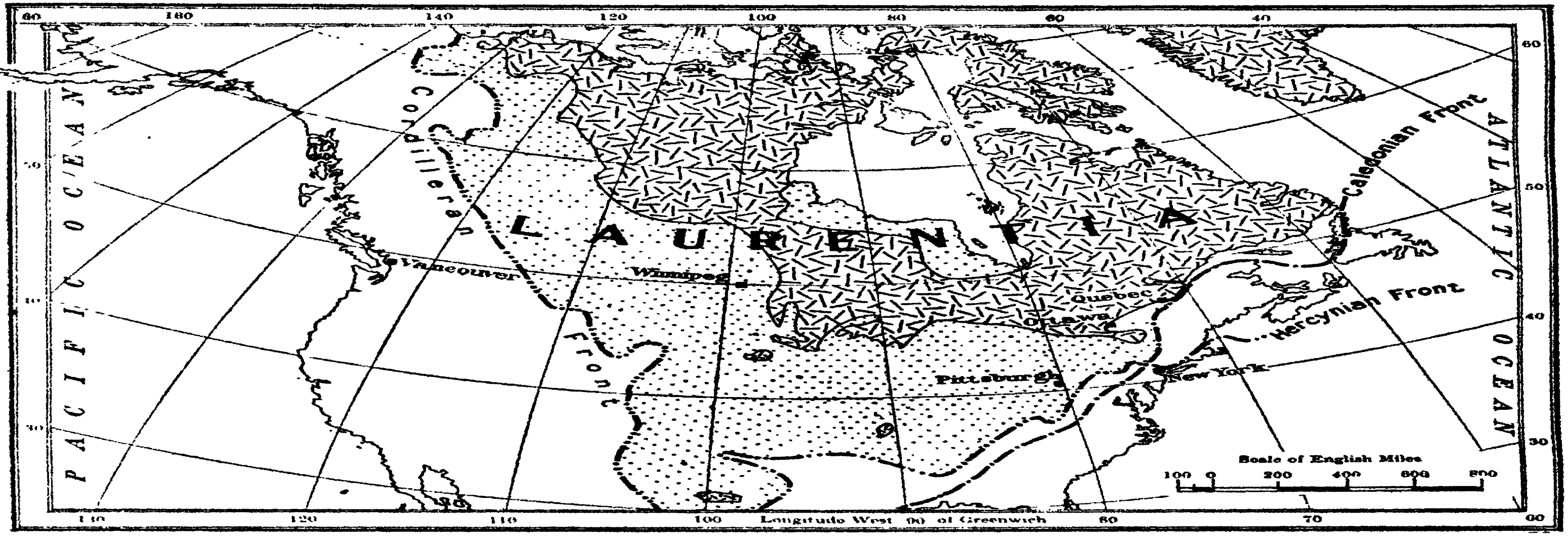

FIG. 2.—Tectonic map of North America. The ornamented region (Laurentia) has remained unaffected by mountain-folding since pre-Cambrian times; its pre-Cambrian outcrops are shown by ticks, Cambrian and later by stipple. The western cordillera is of Mesozoic and Tertiary date.

The date of the Armorican and Variscan folding varies somewhat according to locality, but lies either within, or at latest shortly after the close of, the Carboniferous. Bertrand, publishing the same year as Suess, classed these mountains on a purely age basis, as part of his Hercynian System (called after the Harz). Unfortunately, Bertrand's name Hercynian was preoccupied; but I propose to use it in his sense in the present description.

The Franco-Belgio-German coalfield at the northern front of the Hercynian Mountains has provided a favourite theme among tectonists from the days of Dumont and Rogers, 1832 and 1849. In 1877, Cornet and Briart, and in 1879, Gosselet, announced large-scale overthrusting, the first of the kind to be recognised in European Palæozoic chains. Of recent years, much the most delightful addition to our knowledge of the ground has been afforded by Fourmarier's 1905 interpretation of the Window of Theux, south of Liège.

The preparatory hinged subsidence that we have met with in the history of the Caledonian Chain, in southern Scotland and again in Canada, reappears in the Hercynian record of western Europe. Broadly speaking, the Devonian of the Hercynian Foreland is continental (Old Red Sandstone), while that of the Hercynian Mountains is marine. Evidently the marine Devonian gathered on a tectonic slope that, descending southwards to the site of the future mountains, was constantly renewed by subsidence.

The contrast between the foreland and the mountain region is particularly striking along the Franco-Belgian front of the chain, even when we make allowance for exaggeration by overthrusting. The Lower Devonian and the lower part of the Middle Devonian of the thrust region sometimes total 17,000 feet, while both divisions are absent in the over-ridden foreland to the north. The line at which this great mass of sediment fails is known as the Condroz Crest. I prefer to speak of it, when

concerned with its pre-thrust character, as the Condroz Slope.

During Lower Carboniferous times, marine transgression submerged the Hercynian Foreland far and wide. A northern continent persisted, but its waste was retained along a deltaic belt that stretched through southern Scotland and northern Ireland. Accordingly, clear-shallow waters covered much of the foreland in Belgium, England, and Ireland, where it encouraged the growth of Carboniferous Limestone. At the same time, the interior Hercynian zone, lying to the south, showed signs of mountain development, and its uplifted portions furnished sand and mud to the contiguous sea. It is almost certain that the northward travel of the Hercynian mud was checked by a successor of the Condroz Slope leading down from the shallow waters of the submerged foreland to the foredeep of the growing chain.

Without attempting to sketch this history even in outline, let us pass on to Millstone Grit times, when a slackening in the general subsidence of the foreland allowed deltas from the persistent northern continent to join with others from the growing southern mountains. They met upon the site of the erstwhile Carboniferous Limestone Sea and thereafter placed Scotland in frequent communication with contemporary land regions in France and Germany. Just at this critical time, as Kidston and Traquair have shown, the land flora and estuarine fish fauna of Scotland underwent a remarkably sudden alteration; whereas the fauna of the open sea showed no corresponding change.

The new flora that all at once appeared in Scotland, is one that has been demonstrated by Potonié and others to have arisen in a normal gradual fashion on the deltas fronting the nascent Hercynian Mountains; and I attribute its abrupt introduction into Scotland to migration across the confluent southern and northern deltas of the Millstone Grit. The contemporaneous renovation of the estuarine fish fauna of Scotland can also be explained by the meeting of the deltas, since this event made Scottish rivers tributary to the general drainage system of western Europe.

There is another aspect of the deltaic apron of the Hercynian Mountains which used to appeal insistently to the imagination of Marcel Bertrand. This deltaic accumulation gathered in the frontal depression of the growing Hercynian Chain, and to-day it furnishes the greatest belt of coalfields in the whole of Europe. We know it in Upper Silesia and again in the Ruhr, Belgium, north-east France, Dover, Somerset, and South Wales.

The phenomenon of mountain crossing receives two independent illustrations along the course of the Hercynian Mountains of western Europe. In Upper Silesia the front of the Hercynian Chain emerges from beneath the Carpathians, while in the British Isles it obliterates for the time being the south-westward continuation of the Caledonian Chain. Where the Carpathians and Alps have trespassed upon the domain of the Hercynian Mountains the latter had already been buried beneath an unconformable cover of Mesozoic and Tertiary marine sediments. Similarly, where the Hercynian front crosses the Caledonian Chain in Ireland, the new mountains, at the present level of denudation, consist of Devonian and Carboniferous sediments.

In America, from New York southwards, the north-west front of the Appalachian complex consists of folded and often overthrust Palæozoic sediments that extend upwards into Coal Measures. This belt it was that gave the brothers Rogers material for their ever-famous address delivered in 1842 before the American Association of Geologists. The last great movement seems to have been in the early Permian. Accordingly, Marcel Bertrand, in 1887, placed this frontal Pennsylvanian belt of the Appalachian Complex in his Hercynian System.

The most interesting peculiarity of the Hercynian System in America is its penetration to Laurentia, to the north-west foreland of the Caledonian System. The crossing of the chains, begun in the British Isles, is completed in New England. The actual front of the Hercynian Chain cannot be mapped with precision in the American part of the zone of crossing, because the critical district has been largely denuded of its Carboniferous rocks. At the same time, important Carboniferous outliers do occur in the southern States of New England and are strongly folded; whereas the Carboniferous spreads of the maritime provinces of Canada are tolerably undisturbed. The best known of the New England outcrops crosses Rhode Island, and its prevailing rocks are conglomerate, arkose and slate. Though folded, cleaved, and cut by granite and pegmatite, the Rhode Island Carboniferous agrees with that of Canada in being unconformable to the Caledonian disturbances.

Where at last the Hercynian Mountain front steps clear of its Caledonian predecessor, one encounters a sedimentary superposition of facies that is quite unknown in Europe. In Pennsylvania there is an immense concordant succession from Cambrian to Carboniferous. In the cores of anticlines we find our Durness (Beekmantown) Limestone, because we stand on the north-west foreland of the Caledonian Chain. In the hearts of synclines we discover Upper Carboniferous Coal Measures (Pennsylvanian) derived from the waste of the growing Hercynian Mountains, and we follow Bertrand in our thoughts to South Wales, the Ruhr, and Upper Silesia.

The study that we have made of mountain chains with their folds and their thrusts, which individually may be of the order of 100 miles, involves a recognition of some type of continental drift. Of late years Wegener has developed this idea on a particularly grand scale. He has accounted for many recognised correspondences in the geology of the two sides of the Atlantic by supposing that the ocean has flowed in between the Old World and the New, as the two continental masses, with geological slowness, drifted asunder. One cannot help feeling that Wegener may perhaps be telling us the truth. The available evidence is crude and ambiguous; but it is certainly startling to be confronted on the coasts of Britain and America with what read like complementary renderings of a single theme: the crossing of Caledonian Mountains by Hercynian.

Sir Joseph Banks, Bart.

President of the Royal Society from 1778 until 1820.

THE forthcoming anniversary meeting of the Royal Society is the hundred and fiftieth nniversary of the election of Joseph Banks, the istinguished naturalist and companion of Captain ook in his first voyage of discovery, as president of he Society. Banks was elected a fellow in 1766, hosen president in 1778, and served in that office or a period of forty-one years. Those who comrised the pageant of science during his presidency, hoosing names in a catholic sense and in order f years, included Count Rumford, Cavallo, Desaguliers, William Herschel (who communicated o Banks the name Georgium Sidus for the new lanet), James Watt, Wollaston, Lavoisier, Volta, Davy, Cuvier.

Beyond a wide knowledge of botany and of aces of people, fully appreciated in his case, it is lifficult to gauge accurately—and no attempt is nade here—what Banks's precise hold was on the nen of his time that he should obtain practically ndisputed pre-eminence in the official world of cience. Certainly he was rich, extremely hospiable, a sound friend, and devoid of petty excesses n language. He had the grand manner, the Georgian patriotic instinct, the love of Imperial xpansion. He lived to witness the steps that were aken for the colonisation of Australia and New Zealand.

Joseph Banks was a Londoner, born on Feb. 2, 1743 (O.S.), in Argyle Street, hard by what is now Oxford Circus. His family was of Yorkshire exraction. Sent to Harrow at an early age, at hirteen he was removed to Eton, on leaving there becoming a gentleman commoner at Christ Church, Oxford. Here it was that his love of natural nistory broadened and shaped his future career. Banks was created a baronet in 1781, a Knight of the Bath in 1785, and a Privy Councillor in 1797. He died without lineal issue, at Spring Grove, Isleworth, on June 19, 1820, his wife surviving him.

In the year of his election into the Royal Society (1766), Banks decided to visit Newfoundland and Labrador in quest of botanical specimens, and accepted an offer to accompany Lieut. Phipps, commanding H.M.S. *Niger*, a boat on government service. It was his first venture, his baptism of exploration, and those earlier studies at Oxford in botany and general natural history were now to undergo the test of enlarged opportunities on virgin territory. He kept a journal (ending Nov. 17, 1776)—faithfully treasured at Adelaide, and he collected many plants. But a larger undertaking, which through its magnitude and momentous scope appealed to Banks, was at hand, namely, Cook's projected voyage to the Pacific in the *Endeavour*. Approach was made to the council of the Royal Society requesting a place in the complement. It is recorded that the council "very earnestly" asked the Lords of the Admiralty that in regard to Mr. Banks's great personal merit, and for the advancement of useful knowledge, he also, together with his suite, and with their baggage, might be received on board of the ship in command of Captain Cook. Banks was then twenty-five years of age, and he was the possessor of an ample fortune. The journal which he compiled during the voyage, or rather diary, is a classic. Sir Joseph Hooker, its latter-day editor, refers in eulogistic terms to Banks's untiring activity, whether in observing or collecting animals and plants, investigating and recording native customs and languages, bartering for necessaries with the inhabitants, or preventing the pillaging to which the ship was frequently subjected. Surely a man of vision in advance of his years and period, and a worthy pioneer companion for Cook in strange seas and lands.

There was an incident at Otahite relating to a stolen quadrant. Says Banks (April 2, 1769), "This morning the astronomical quadrant which had been brought ashore yesterday, was missed." To recover this Banks and his colleagues journeyed four miles from their base, only to learn that yet another three miles must be traversed to secure the instrument. But success came. "We packed up all," he writes, "in grass, and proceeded homewards. After walking about two miles we met Captain Cook with a party of marines coming after us."

On the completion of the Pacific voyage, Banks received from his *alma mater*, the University of Oxford, the D.C.L. degree. Soon his portrait was painted by Sir Joshua Reynolds. The metropolis welcomed him with affectionate fervour. So ardent a collector and naturalist could not, however, but seek fresh extension of his studies. In 1772 plans for Cook's second voyage of circumnavigation were going forward, and it was the wish of Banks to accompany him. In regard to the resultant failure, Sir John Barrow, in retrospect, was at no pains to conceal his views. "Such a system," he wrote, "was adopted by the Navy Board to thwart every step of his [Banks] proceeding, whereby his patience was worn out, and his indignation so far excited as to cause him, though reluctantly, to abandon this enterprise altogether." Instead, Banks directed his energies towards organising and equipping a scientific expedition to Iceland. He sailed on July 12, 1772, and much valuable material accrued through his efforts and those of his coadjutors.

Most men of science know that numbers of Banksian letters and records were dispersed long ago through the medium of auction sales. In the case of Banks's Iceland journal, fortunately, through certain favourable circumstances arising after his death, a copy was made, and it is pleasing to direct attention to the issue, this year, by the Cornell University Library, of the work "Sir Joseph [illegible] Iceland." The author and

annotator, Dr. Halldór Hermannsson, prints the following significant paragraph: "This manuscript, with other of Banks's papers, went to the family of his wife, and Lord Brabourne, a relative [great nephew] of hers, finally sold them at a public auction in 1886, and its whereabouts (*i.e.* original MS.) is unknown, if it is still in existence." It was Lot 21 in the sale.

After his Iceland tour, Banks established himself at a house in Soho Square, and thenceforward devoted himself to the advancement of science in fulfilment of personal hopes and aspirations. On Mar. 16, 1820, Banks occupied the presidential chair at the Royal Society for the last time; for reasons of health he very shortly intimated his wish to resign his charge. Upon solicitation he withdrew his resignation; but in June following he died, and, like Newton, whilst in office. The Royal Society possesses a portrait of Banks, painted by Thomas Phillips, R.A.

Obituary.

Sir Hugh Anderson, F.R.S.

SIR HUGH ANDERSON, who died on Nov. 2, was one of the most influential and the best-loved men in Cambridge. Modest to a fault and ready to see merit in all but himself, he was nevertheless a far-sighted and resolute administrator, and the driving force behind most of the recent changes in the University. But a man of science who is modest about his own work and is withal a capable man of affairs must be drawn almost inevitably to the administrative side. Anderson's research work came to an end in 1905, when the calls on his time became more and more urgent. For many years he hoped to return to the laboratory to work at his unfinished problems 'when he had a moment to spare,' but he never had that moment. In the end he used to say that he was out of it for good, and that all he could do was to encourage the younger men. But the truth is that he was never out of it, for everyone came to him for sympathy and advice, and his wise guidance has had an indirect effect on the scientific work of the University which it would be hard to overestimate.

Anderson's own research work was mostly carried out in collaboration with Prof. Langley, and dealt with the then obscure problem of the nerve supply to the viscera. To Langley must belong the credit of producing the complete systematic account of the autonomic nervous system as we know it to-day, but the papers which he published with Anderson mark the most important phase of the whole work. The arrangement of the sympathetic system had been made fairly clear by Gaskell's morphological work and Langley's brilliant application of the nicotine method, but there remained the more difficult problem of the cranial and sacral autonomic nerves, and in the course of twelve years—from 1892 to 1904—Langley and Anderson worked together, tracing out the innervation of the iris and of the pelvic viscera and arriving finally at a complete account of the parasympathetic system. In their final papers they rounded off their work by experiments on the union of different kinds of nerve fibres.

In 1905, Anderson published two papers of his own, analysing the effect of drugs on the iris and clearing up various points which remained obscure in its nervous control, and then administrative work claimed him. But although his research work extended only from 1892 to 1905, it was throughout of a very high order; it produced results of the first importance, and it left him with a vivid interest in the physiology of the nervous system, and a power of illuminating suggestion and criticism which never seemed out-of-date. It left him, too, with an insight into the difficulties of the scientific worker which made his advice so much sought after by colleagues of all generations, and in the end we may hope that a partial realisation of the encouragement and help he gave to others may have consoled him a little for his own unfinished researches.

Anderson's work for the Royal Commission on Oxford and Cambridge, for the medical and biological schools, and as Master of Caius, make an impressive record of service to learning; but no record can do full justice to the vivid and friendly personality of the small, active figure whose loss means so much to his University.

WE regret to announce the following deaths:

Dr. H. M. Benedict, professor of botany in the University of Cincinnati, and a former president of the Ohio Academy of Science, who carried out work on senility in plants, on Oct. 17, aged fifty-four years.

Mr. Douglas J. P. Berridge, for several years secretary and recorder of the Educational Science Section of the British Association, and for thirty-four years science master at Malvern College, on Nov. 11, at fifty-nine years of age.

Prof. C. O. Esterly, professor of zoology at the Occidental College, Los Angeles, and zoologist at the Scripps Institution of Oceanography, California, a distinguished worker on copepods who was president of the American Microscopical Society in 1925, on Aug. 10, aged forty-nine years.

Dr. Josef Hepperger, former professor of astronomy in the University of Vienna and Director of the Observatory, on Sept. 13, aged seventy-three years.

Mr. Alfred Smetham, a past president of the Society of Public Analysts and an original member of the Society of Industrial Chemistry, who had much experience of the agricultural side of chemistry, on Oct. 11, aged seventy-one years.

Sir Nestor Tirard, emeritus professor of medicine at King's College, London, and senior editor of the 1914 edition of the "British Pharmacopœia," on Nov. 10, aged seventy-five years.

Mr. Edmund White, president from 1913 until 1918 of the Pharmaceutical Society, who was intimately associated with the 1911 and 1923 editions of the British Pharmaceutical Codex, on Nov. 5, aged sixty-two years.

News and Views.

At the annual dinner of the Royal Society of Medicine, held on Nov. 15, Mr. Rudyard Kipling, who was one of the guests of honour, disappointed and mystified his audience by a discourse on Nicholas Culpeper, the astrologer physician who flourished in the first half of the seventeenth century and gained considerable notoriety by an unauthorised translation of the Pharmacopœia of the Royal College of Physicians and a work on herbal medicine which had an enormous vogue for nearly two centuries. His theory was that "this creation, though composed of contraries, is one united body of which man is the epitome, and that he, therefore, who would understand the mystery of healing must look as high as the stars." This view, according to Mr. Kipling, was derived from the doctrine of the old Greek philosophers, that the universe is one in ultimate essence, which essence is sustained, embraced, and interpenetrated by the pneuma, a creative motion or inner heat. Mr. Kipling suggested that if Culpeper were to return to earth to-day, he would have no difficulty in explaining the progress made in the art of healing since his time. It is true that he would find by a visit to Greenwich Observatory that the study of the heavens is not carried on with any relation to diseases or epidemics, but the therapeutic action of radium on morbid growths he would regard as an example of celestial influence. Mr. Kipling, who, like many other literary men throughout the ages, shows a sympathy for the quack as opposed to the orthodox medical practitioner, is inclined to think that Culpeper's views were not really so absurd as they appear, and suggested that at some future time, when the bacteriologist and physicist are at a standstill, they should lay their problem before the astronomer. We doubt very much whether such collaboration would be either probable or profitable.

Sir James Crichton Browne celebrates his eighty-eighth birthday on Wednesday next, Nov. 28, and most hearty congratulations are extended to this veteran member of the scientific world. Educated in the first instance at Dumfries Academy, afterwards at Trinity College, Glenalmond, he graduated in the medical faculty of the University of Edinburgh. An authority on mental and nervous diseases, Sir James was Lord Chancellor's Visitor in Lunacy from 1875 to 1922. For a long term of years, beginning in 1889, he was treasurer of the Royal Institution. He was elected a fellow of the Royal Society in 1883, and is Hon. LL.D. of St. Andrews and Aberdeen, and Hon. D.Sc. of Leeds. Possessing in unusual measure the gift of graceful speech and apt verbal expression, Sir James has always commanded public interest. We recall a notable utterance within the Royal Institution on the occasion of the death of John Tyndall in 1893: "I think I may venture to say that it is good for us to be here this afternoon—to withdraw ourselves for a brief period from business pursuits or pleasures, to assemble together in a place hallowed by the life-work of a great man who has just passed from amongst us—to build an altar to his memory, to burn therein the incense of our gratitude and admiration." While the demands of a busy professional life have not allowed Sir James to engage directly in the preparation of scientific papers, he is the author of some books and of various essays and addresses indicative of versatility and judgment. Among the former may be instanced "Dreamy Mental States" (1898), and "Prevention of Senility" (1905); in the latter category, "Victorian Jottings" (1926) and "Stray Leaves from a Physician's Portfolio" (1927).

We congratulate Sir Jagadis Bose, F.R.S., on the attainment of his seventieth birthday, which falls on Nov. 30. It is a satisfaction to know that the event will find him still actively engaged in the researches which, for thirty years, he has prosecuted on the sensitivity and motility of plants, researches which have contributed so much to the knowledge and understanding of their organisation, and have made him so widely known. Bose approached the subject from the physical, not the physiological side, and to this much of his success is attributable. Although as an undergraduate at Cambridge he attended the courses of physiology and of botany, his attention was chiefly devoted to physics, which he studied under the late Lord Rayleigh, at that time Cavendish professor of physics in the University, who formed a high opinion of his abilities and afterwards strongly supported his candidature for the fellowship of the Royal Society on account of the merit of his electrical researches.

The observation of electric phenomena presented by metals led Bose to extend his experiments to living matter. The researches of du Bois-Reymond and other physiologists had shown that functional activity of animal tissue, whether muscle, nerve, or gland, is accompanied by an electric variation detectable by the galvanometer. Bose applied this method to plants, beginning with the motile leaves of the sensitive plant, *Mimosa pudica*, and found that their movement is accompanied by an electric variation like that of contracting muscle. Nor is this reaction confined to actively motile 'sensitive' plants: for he observed it when any part of any living plant was stimulated, even although the responsive movement was almost imperceptible. Sensitivity and contractility are then fundamental properties of the living protoplasm of which both plants and animals consist. Bose's early physical training developed his natural gift for devising ingenious and highly sensitive apparatus, by means of which it was possible to record automatically the usually rather feeble response of the plant to stimulation, and to discover in the plant-body the channels along which 'nervous' excitation travels, and the sap is propelled by the rhythmic contraction of propulsive cells, which may be regarded as his crowning achievement. Naturally, such results as these have not escaped criticism, but no rebutting experimental evidence has been adduced. No good wish will be more welcome to him on this occasion than that he may live to see the Research Institute which he has founded at Calcutta developing into an active centre of fruitful investigation in all branches of biology.

IN the *Daily Mail* for Nov. 14 there appears under headlines of the usual startling character a description of an invention which, it is alleged, will revolutionise all our present ideas about electricity. It is true that the article begins with "If the claims made for the Harrison-Wood patent are substantiated," but the impression produced is that it is quite possible that the manufacture and distribution of electric energy may become obsolete. We are told that the inventors claim that by attaching a small machine to an equally small accumulator an average sized villa can be illuminated for an indefinite period at a trifling cost. If the villa is already equipped for electric supply, all that is necessary is to put a plug in the socket of the nearest lampholder and the machine will reduce the annual cost to one-sixth its present value. The *Daily Mail* says that "it is stated" that this has actually been done over a period of some months, and it is to be done again for the Government test. We wonder which particular department of the Government is seriously undertaking this test. We do not think that any useful purpose is served by a paper publishing preposterous claims under heavy type, especially when it takes no responsibility for them and states nothing to justify them. Sudden outbursts like this—sensational in presentation and unscientific in substance—can only do harm and are much to be deprecated.

AN exhibition, which suggested possibilities for Nature preservation, was held in Edinburgh on Nov. 14–16. It was the first Silver Fox Exhibition to be held in Scotland—the third of its line in Britain. This show of some 150 silver foxes, the best individuals from the stocks of a score of fur-farms in Great Britain, demonstrated at once the success in quality which has attended the propagation in artificial conditions of a wild and shy animal, and the hold which the new industry has taken. The silver fox is a sport of the American red fox, but the name is unfortunate, since the 'silver' is confined to a slight whiteness or 'frosting' on the tips of jet black hair. Indeed, the classification adopted by breeders grades the animals according to the amount of surface upon which 'frosting' is developed, from three-quarter silver, half silver, quarter silver, to a pure black. The silver-fox sport occurs in Nature, and has been known to turn up in litters with normally reddish young, but the strain seems now to be well established as a domesticated race. The natural skins were always highly prized and fetched large prices at the fur auctions, but the fact that pelts of the best quality can now be bred is bound to affect the intensity of the slaughter of the wild stock, and so indirectly to act towards the preservation, or rather against the extermination, of the native animals. In normal course it ought also to bring about a reduction in the price of the furs, for scarcity and high prices are generally closely correlated. But the intrinsic beauty of texture and colour of the pelts of the show animals exhibited in Edinburgh is sufficient guarantee that the skins will always be in great demand, so long as fur is in fashion. This is shown by the prices demanded for well-bred stock animals—one important fur-farm near Edinburgh offering cubs from selected litters at prices ranging from £100 to £300 each. Such prices suggest that the competition for good pelts is very keen, and perhaps also that silver-fox breeding is no child's play.

PROF. PONTE's predication on Nov. 8 that the eruption of Etna would last at least another week has been fully justified, for the emission of lava appears to have continued up to the evening of Nov. 16. From then the lava became increasingly viscous, and by Nov. 18 it had solidified, at least superficially, right up to the last of the active sources. Prof. Malladra, the Director of the Vesuvius Observatory, has spent several days investigating the nature of the eruption. He estimates the average daily output of lava at 46 million cubic yards, and states that the initial temperature was 1030° C. It has also been recorded that from one of the craters the effervescent lava rose in a glowing fountain for 50 feet, and at night was "the colour of molten gold." The gases and vapours given off during the earlier stages of the eruption seem to have been unusually mild, water-vapour predominating. The close of the eruption, however, was marked by the appearance of sulphurous gases. Although the eruption has been a relatively minor one—that of 1892, for example, lasted six months and discharged an enormously greater flood of lava—the damage to property has unfortunately been more than usually severe. In addition to the destruction of villages and services, nearly 2000 acres of vineyards, orange and lemon orchards, and chestnut groves have been totally destroyed, the loss amounting in all to the value of £2,000,000. Vesuvius began to display increased activity on Nov. 14, but this is of a normal character. There is no ground for the suggestion that Vesuvius is acting in sympathy with its more vigorous neighbour. The habits and lavas of the two volcanoes are of widely different types.

ACCORDING to the *Revue Générale des Sciences* of Oct. 15, the great electromagnet which M. Cotton has built for the Paris Academy of Sciences has now been completed and is installed at Bellevue at the national office for scientific research. The object in view in constructing this electromagnet was quite different from that which Kapitza had in constructing the Cambridge electromagnet. In the latter, magnetic fields having intensities of several hundreds of thousands of gausses are produced for periods of about the hundredth part of a second. They exist also only in the interior of little bobbins. The French electromagnet produces intense permanent fields of appreciable volume. The field produced by an electromagnet can be increased almost without limit by using polar points worked and centred with geometrical accuracy. The total weight of the new magnet is 120 tons, of which 105 are iron and 9 are copper. In a space bounded by two faces four centimetres in diameter and two centimetres apart, a magnetic field the intensity of which was 43,500 gauss was obtained. By the use of ferro-cobalt pole pieces, this field can be increased by about 6 per cent.

MANY electrical undertakings in Great Britain will soon be converted from generating stations into supply stations, and this will ultimately be for the benefit of the consumers. It is advisable, therefore, that attention should be devoted to the problems that are arising out of this national reorganisation of the electricity supply in order that justice be done to those who are affected by it. In particular the question of the displacement of the staff requires careful study. We are glad, therefore, that Mr. W. J. Bache discusses this question in his chairman's address on "Problems of Electricity Supply" to the western centre of the Institution of Electrical Engineers. The engineers and workmen who have served undertakings efficiently and loyally and now, through no action of their own and for the benefit of the nation, may lose their normal occupation, are entitled to generous treatment. The questions of the probable number of men to be affected and the possibility of many of them being still retained in their own undertakings should be considered. There are about 570 undertakings in Britain and the total number of generating station engineers likely to be affected is a little more than a thousand. Mr. Bache thinks that if both sides show good will and a spirit of reasonableness, there should not be much difficulty in providing employment for the displaced technical men in their own undertakings. He points out, however, that the specialised knowledge and experience obtained by a generation engineer does not necessarily qualify him to be equally useful as a distributing engineer. It is necessary that he obtain further knowledge. He must supplement his book knowledge by observation of the practical processes of the new work he will have to do. As the assistant engineer usually has an eight-hours' day, Mr. Bache thinks that he can devote a few extra hours every week to acquiring the necessary practical knowledge. For example, he allows his own assistants to aid in the work of the mains department, in laying cables, in managing substations, in testing meters, in inspecting installations, and in office work dealing with consumers' accounts. We hope that his example will be widely followed.

THE fate of Colonel Fawcett in the Brazilian forests seems to have been established beyond reasonable doubt by Commander Dyott's recent expedition, although no conclusive proof of the Indian reports was obtainable. The story is pieced together from Com. Dyott's dispatches in the *Geographical Journal* for November. In April 1925, Col. Fawcett started into the very difficult country about the head-waters of the Paranatinga and Xingu Rivers, and no news has been received from him since a dispatch dated May 30 in that year from Dead Horse camp in lat. 11° 43′ S., long. 54° 35′ W. From the Cuyaba River, a tributary of the Paraguay, Com. Dyott reached the Kuluene River, one of the head streams of the Xingu, and there obtained news that Col. Fawcett had been killed by Indians five days after passing east of the Kuluene River. Com. Dyott followed some distance in the tracks of Col. Fawcett's party and obtained confirmation of this story. Eventually, however, owing to the hostility of the Indians, he was forced to make a hurried retreat down the Xingu. Further details are awaited on the return of Com. Dyott.

THE improvement in typography during the last twenty or thirty years has been slow in making its influence felt in the lettering on maps. In a lecture before the Royal Geographical Society on Nov. 12, Capt. J. G. Withycombe traced the development of cartographical lettering. Until the latter half of the eighteenth century the alphabets used were evolved from hand-written script in Roman lowercase and Italic type. The Roman capitals were carefully drawn and often treated decoratively. The alphabets deteriorated when a commercial round hand or 'copper-plate' took the place of the pointed Italian script. Hair lines were introduced and the proportions of the letters altered. The capitals were narrowed and the serifs so exaggerated that they concealed the distinctive form of the letters. The type lost in beauty and legibility. The Ordnance Survey has always been noted for the neatness of its lettering, but now that the helio process has entirely replaced the copper plate, improvements in typography are to be introduced in the revision of the 1-inch map that is to be begun shortly. In the Roman capitals the proportions of the letters have been restored and the serifs are not too obtrusive. Violent contrasts between up and down strokes do not appear, and the white spaces within the letters are clean. The lowercase alphabet is based on pen strokes. The Italic alphabet is rounder and more legible, and there are no hair lines. Altogether, the new alphabets show considerable typographical improvement on the old.

IN his opening lecture at the Royal Academy of Arts, delivered on Nov. 14, Prof. A. P. Laurie dealt with the scientific examination of pictures. A microscopic examination gives valuable information as to repainting, and also makes it possible, in many cases, to identify the pigments used; this examination having, in some cases, to be supplemented by tiny samples taken with a fine hypodermic needle. As new pigments have come in from time to time in the history of painting, and others have disappeared from the artist's palette, they form an invaluable guide for fixing the date of a picture, and, in addition, it is sometimes found that the palette of a given artist is peculiar to himself. The microscope also enables forged signatures to be detected. Another useful weapon is the X-ray photograph. By this means it is possible to detect whether one picture has been painted over another, and also whether the artist has made alterations—such alterations indicating that the picture is genuine, and is not a copy or a replica. The X-rays are also very useful in detecting repairs or, rather, in showing whether repainting covers extensive repairs and, therefore, cannot be safely removed. Magnified photographs of the brush-work are of great assistance in deciding whether a picture is by the master or by one of his school. Recent scientific research has also enabled additional methods to be discovered which are not yet sufficiently advanced for publication. Dealers and connoisseurs have been very slow to realise the valuable work that can be

done by means of scientific investigation, but, now that the public is beginning to realise the possibilities of scientific research in this direction, the time is coming when no important picture will be sold without a scientific report, and a scientific laboratory will be considered part of the necessary equipment of the national galleries of Europe.

THE Research Association of British Rubber and Tyre Manufacturers can be congratulated on the Library Catalogue, and the periodic Summary of Current Literature issued to its subscribing members. They give evidence of the most careful attention to type and lay-out—matters which are too often overlooked—and they are printed on excellent paper. Some idea of the growing perplexity of the problems confronting any particular industry can be gathered from the fact that this special library, which owes much to the enthusiasm of Dr. S. S. Pickles, chairman of the Library and Information Bureau Committee, now contains nearly two thousand volumes of books and British and foreign periodicals, and a larger collection of pamphlets. The Summary of Current Literature contains abstracts of papers under the following headings: planting, latex, raw-rubber (its preparation and properties, treatment and applications), gutta-percha, compounding ingredients, fibres and textiles, vulcanised rubber (including its various uses), general works processes and materials, machinery and appliances, organisation, commerce and statistics, chemistry and physics, English patents. Obviously the indexing, cataloguing, and abstracting of this varied material is a task of considerable magnitude, demanding for its proper performance special acquaintance with the needs of the industry, a knowledge of foreign languages, and a thorough grasp of the trend of modern research work. It is a costly undertaking, and beyond the resources of most individual firms. For this reason alone industrial research associations are an imperative necessity, particularly to small concerns, which unfortunately are usually the last to appreciate the worth of co-operative research activities.

THE third triennial Empire Mining and Metallurgical Congress is to be held in South Africa in 1930, at the invitation of the Union Government. An executive committee has been appointed by the South African constituent institutions, and an attractive programme is in course of preparation. The Congress will commence in Cape Town on Monday, Mar. 24. A tentative itinerary has been arranged, which comprises visits to all the principal mining centres in the Union and Rhodesia, as well as places of scenic interest. There will be opportunities of visiting the diamond mines at Kimberley, the gold mines and works of the Witwatersrand, the gold, diamond, platinum, coal, asbestos, and copper mining districts in the Transvaal, and the Sabie Game Reserve. The Rhodesian tour will include the Victoria Falls, gold, copper, zinc, lead, asbestos, and coal mines, and the Zimbabwe Ruins. Members will also be enabled to visit the coalfields of Natal, as well as some of the beauty spots of that Province and the Port of Durban, returning to Cape Town by a circuitous route which will take in Bloemfontein, Port Elizabeth, Oudtshoorn (Cango Caves), and the Knysna Forest. Opportunities will also be afforded of visiting some of the more important industrial developments throughout the country. Sessions will probably be held in Cape Town, Kimberley, Johannesburg, Bulawayo, and Durban. The itinerary, as planned provisionally, will occupy 47 days, the whole distance being a little more than 7000 miles; special trains will be provided by the South African Railway Administration. It is hoped that the total inclusive cost of the tour in South Africa will not exceed £140. The secretary of the Congress is H. A. G. Jeffreys, 100 Fox Street, Johannesburg, Transvaal.

AT University College, London, on Nov. 16, Dr. W. Perrett gave a very interesting demonstration in support of his theory of the 'tierce-tone scale,' so called because each tone is divided into three parts. The apparatus used for the demonstration consisted of a set of tuning-forks, carefully tuned to the ordinary diatonic scale, supplemented by a second set of forks, also forming a diatonic scale, but a Greek semitone above the first set, the interval of the Greek semitone being 20/21. There were further five supplementary forks, introduced to give the scale of C minor. With this battery, Dr. Perrett showed that it is possible to form a harmonically correct common chord on any note of the scale, there being of course no tempering in the scale. The acceptability of the scale to the modern ear is a matter which can only be decided by experiment, but there is no doubt that to the ear of ancient Greece such intervals as 5 to 7, and 7 to 10, taken exactly, were grateful. Dr. Perrett announced that a keyboard instrument, which will enable compositions to be played with his scale, is now in course of manufacture. When completed it will obviously enable more satisfactory tests to be made than are possible with a tuning-fork battery. A further interest of the tierce-tone scale is that it may form a link between the music of the East and of the West, since intervals less than a semitone are generally used in the non-harmonic music of the East.

THE Rochdale Literary and Scientific Society celebrated its jubilee on Friday, Nov. 9. The Society was founded on Nov. 9, 1878, and has grown to be an important local institution for the promotion of scientific investigation. It was among the first to investigate, if not discover, the flint implements used by pre-historic man on the Pennines, and has contributed several fossils new to science to the British Museum. It first issued Herr Stolpe's English translation of "Ornamental Art of Savage People," which has just been reissued by the Swedish Academy Aktiebolagen Familijeboken. The Society has also made an exhaustive investigation of the Roman Road on Blackstone Edge, which the authorities have recently decided to schedule as a National Monument. Prior to the jubilee celebrations, the Society presented to Dr. J. R. Ashworth his portrait in oils, painted by the Hon. John Collier, in recognition of his forty-three years' honorary secretaryship of the Society.

THE Technological Museum of the Department of Public Instruction, New South Wales, is largely concerned with problems of economic importance to the State, in the departments of chemistry, zoology, and botany. The Annual Report for 1927, prepared by the recently appointed Curator, Mr. A. R. Penfold, shows that the scientific staff investigated, on the chemical side, essential oils and poisonous properties of Australian plants, dugong oil, and oil from the livers of sharks, as well as various substances fondly believed by the finders to be ambergris. The zoologist continued his work on the life-history of the king prawn, and on the sex-ratio of New South Wales commercial oysters (*Ostrea cucullata*), while the botanist carried out mechanical tests upon many timber samples, and studied the tanning properties of bark, particularly in connexion with wattle bark. The occupation of the staff in such scientific activities would appear to leave little opportunity for museum exhibition work, for apart from the rearrangement of certain of the art collections no reference is made to the public galleries, which were visited by 65,000 persons during the year.

THE council of the Geological Society of London announces the receipt of a generous gift of 10,000 dollars of Dominion of Canada 4½ per cent Bonds from Mr. J. B. Tyrrell, the well-known Canadian mining geologist, for the foundation of a fund, to be known as the J. B. Tyrrell Fund, the interest of which is to be devoted to the furtherance of knowledge of the geology of the Dominion of Canada among the geologists of Great Britain and Ireland. The first award from this fund will be made in February next, and applications are invited from British and Irish geologists who desire to visit the Dominion of Canada for the purpose of study or research, and require assistance in the payment of the necessary travelling and living expenses. The amount of the fund available for the award is £100. Details of the conditions governing the disbursement of the fund, and of the form of application required, can be obtained from the secretaries, Geological Society of London, Burlington House, Piccadilly, London, W.

THE issue of the *Physikalische Zeitschrift* for Sept. 1 contains a description by Dr. W. Meissner of the new low-temperature laboratory at the Reichsanstalt and its equipment. With the exception of a portion of the equipment provided by the Notgemeinschaft, the funds were provided by the German government. The ground floor plan is 100 ft. by 40 ft., the centre half being occupied by the machinery for liquefying gases, and the two ends by the machine shop and the laboratories respectively. Below part of the machinery room is a basement, and over the ground floor laboratories are laboratories on the first floor. The gas liquefaction plant is capable of producing 20 litres of liquid nitrogen, 10 litres of liquid hydrogen, and a small quantity of liquid helium per hour. With the help of the latter, observations at temperatures in the neighbourhood of 1·2° absolute have been made. Great precautions have been taken to avoid escape of hydrogen and sparking of electrical machinery, but in case of an explosion the doors are arranged to move bodily outwards and the roof to lift in one piece. Details are given of the liquefying plant, and it is stated that use of the facilities of the laboratory will be open under certain conditions to workers not on the laboratory staff.

A NOTEWORTHY commemoration of the tenth anniversary of the foundation of the Czechoslovak State, celebrated on Oct. 28, was the gift of Dr. Josef J. Frič's Žalov Observatory to the Charles' University of Prague. The observatory is at Žalov, near Ondřejov, 36 km. south-east of Prague. Two enthusiastic astronomers, Joseph and Jan Frič, established their own workshop in 1883 in Prague to enable them to build the observatory. After the premature death of the brother Jan in 1897, Joseph Frič alone undertook the great task of fitting up the observatory from his workshop, which has since developed into the well-known factory for the manufacture of surveying, astronomical, and polarising instruments. In memory of his deceased brother, Joseph Frič called the Observatory Hill 'Žalov' (the place of sorrow). The buildings consist of a studio, two domes, and four smaller observing houses situated in a beautiful park on the top of the hill among deep forests, in a country free from industrial works. It is equipped with an 8-inch Alvan Clark Refractor and other modern instruments, and contains a fine astronomical library with recent and ancient prints. This property, worth more than 3,000,000 Kč. (about £20,000), has been presented to the Faculty of Sciences of the Charles' University, to promote advanced research in astronomy.

OF the articles in the October number of the *Natural History Magazine*, the most outstanding is Dr. John Parkinson's account of the work of the British Museum East Africa Expedition, under the title "The Dinosaurs of Tendaguru." Other interesting, though less original articles, deal with the Bactrian camel, showers of fish, the fluorescence of minerals, and the control of locusts. The last paper deals more with the life history of these pests than with control proper, no mention, for example, being made of the elaborate systems of ditches, corrals, and traps recommended by the Agriculture Department of the Argentine Government, but it points out that ultimate effective control must have a biological sanction, and must be concentrated rather upon the breeding-grounds than upon actual migratory flights. The present number, the eighth in the series, concludes the first volume of the magazine, and a full index shows how varied has been the fare provided by the staff of the Natural History branch of the British Museum.

THE first part of a new publication, the *Bulletin of the Raffles Museum* (No. 1, Sept. 1928), Singapore, Straits Settlements, has come to hand. Hitherto this museum has had no journal of its own, and papers written by the staff and others on its collections have had to seek publication in the journals of various societies and institutions. The *Bulletin* will be issued as material becomes available, each part being complete in itself, and when sufficient parts are published they will form a volume. This first part is devoted to by Dr. R. Hanitsch, dealing

with the Blattidæ of the Mentawi Islands: fifty-three species are enumerated, of which nineteen are new, together with one new genus. The paper consists of 44 pages, with two plates, and the part is sold at 60 cents, or 1s. 6d., by the Museum.

SIR ARTHUR KEITH will deliver the Huxley Memorial Lecture of the Royal Anthropological Society in the lecture room of the Royal Society on Nov. 27 at 8.30 P.M., taking as his subject "The Evolution of the Human Races."

PROF. W. E. GIBBS, the newly appointed Ramsay professor of chemical engineering in the University of London, University College, will deliver a public inaugural lecture on Dec. 3, at 5.15 P.M., taking as his subject, "Chemical Engineering Education and Research in Great Britain."

MR. B. D. H. WATTERS, of the Physics Department, Middlesex Hospital, has been appointed science editor of the *British Journal of Actinotherapy*, recently vacated by Dr. L. T. M. Gray through pressure of business. Mr. Watters is associated with Prof. Sidney Russ at the Middlesex Hospital, and has contributed to the advance of actinotherapy and actinology in various directions.

BY direction of the Minister of Health, the Committee on Maternal Mortality has drawn up an inquiry form for the investigation of maternal deaths due to pregnancy or childbirth, to be used in such inquiries by medical officers of health, so that the data may be collected in a generally uniform manner. The form is now being issued, together with an explanatory note and a covering letter from the Ministry (*Circular* 934).

IN a notice of Mr. J. B. Scrivenor's volume, "The Geology of Malayan Ore-Deposits" (NATURE, Nov. 17, p. 767), it was remarked that some of the fundamental facts of Malayan geology are left in uncertainty. Such questions will no doubt be discussed in a volume on the general geology of Malaya which, we are informed, is being prepared by Mr. Scrivenor.

IN reviewing Burton's "The Water Supply of Towns and the Construction of Waterworks" (NATURE, Nov. 10, p. 721), reference was made to inclusion at the end of each volume of trade advertisements of firms specialising in water supply appliances. Mr. Dumbleton, editor of the new edition of the work, informs us that all negotiations in respect of advertisements were conducted entirely by the publishers. In the preface it is stated that where special products of individual manufacturers are mentioned, these are quoted as representing a type and are not recommended as preferable to any other similar products. Mr. Dumbleton says that, so far as he is concerned, this applies equally to advertisements.

A PARAGRAPH referring to the movement to establish a central museum in Twickenham was published in NATURE of Nov. 17, p. 781. Mr. C. Carus-Wilson, whose election as mayor of the borough will give much satisfaction to his many scientific friends, writes to correct one or two misapprehensions which may have been conveyed by our note. It appears that the meeting mentioned was not public, but a meeting of supporters of the scheme only, convened for the purpose of forming a committee to develop the museum pending its formal transference to the Corporation on completion. From the first, Mr. Carus-Wilson has only advocated the preservation of objects of local interest, and his experience of museums and museum work of many kinds should ensure that a collection of real scientific and educational value will eventually be established at Twickenham.

WE have received an interesting and well-illustrated little book of 25 pages, which gives many technical details concerning Imperial plates for process work (Imperial Dry Plate Co., Ltd., Cricklewood, N.W.2). Photomicrographs of half-tone dots show the superiority of these plates without any after-treatment even to wet collodion plates after the usual 'cutting' and intensification. The issue is free but the edition is strictly limited.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in agricultural biology at the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot (Dec. 1). A director of the laboratory for clinical investigations at the Manchester Royal Infirmary—The Registrar, The University, Manchester (Dec. 3). An assistant pathologist in the Pathological Department of the London School of Clinical Medicine, at the Dreadnought Hospital—The Secretary, Seamen's Hospital, Greenwich, S.E.10 (Dec. 4). An electrical engineer and a mechanical engineer as technical assistants at the Royal Arsenal, Woolwich—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S.E.18 (Dec. 8). An agricultural engineer in the Burma Agricultural Department—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Dec. 14). A lecturer in physiology as applied to hygiene, at the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, Malet Street, W.C.1 (Dec. 20). A Geoffrey Duveen travelling studentship in oto-rhino-laryngology in the University of London (open to graduates of the University of London in medicine and surgery)—The Academic Registrar, University of London, South Kensington, S.W.7 (Dec. 31). A research officer in the Civil Veterinary department of the Government of India for research in connexion with the diseases of elephants, draught buffaloes and other domestic animals in Burma—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 31, 1929). A pathologist and bacteriologist at the Cumberland Infirmary, Carlisle.—The Secretary, Cumberland Infirmary, Carlisle. A cytologist in the genetics department of the Research Station at Trinidad of the Empire Cotton Growing Corporation—The Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, S.W.1. Two junior assistants under the directorate of ballistics research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Research Items.

ROMAN BRITAIN.—The Ordnance Survey has published a second edition of the map of Roman Britain (Southampton: Ordnance Survey. Price 4s.), which contains a number of additions and differs in other respects from the first. Land between 50 and 100 feet is now indicated by a layer-colour, and submarine contours and hypsometric colouring are added. Regions of natural woodland have been restored on a geological basis. The area shown has also been enlarged. This has made it possible to show the Roman Wall in Scotland and the military remains of Strathmore. In addition to the towns and military camps, the map shows 'villas' and other large houses, villages, permanent settlements, as indicated by finds, and inhabited caves. An introductory note discusses the character and distribution of villas and their relation to native villages, which appear to be complementary to villas. They cluster, for example, on Salisbury Plain, where villas are almost entirely absent. Almost entirely agricultural, they are found among the Celtic fields revealed by air survey. The relative distribution of chalk downs and clay as shown, the latter being covered with woods, brings out the control of settlement by vegetation and the preference shown for the chalk in the distribution of villas along the North and South Downs, converging to the most extensive group on the Hampshire uplands. A comparison of the two editions of the map affords an index to the progress of research discovery in Roman Britain, especially to be marked in several important additions to our knowledge of the road system, the most noteworthy being the western road into Scotland from Carlisle by Birrens, Burnswark, and Annandale towards Clydesdale and the western end of the Scottish Wall.

A SOUTH INDIAN GAME.—In *Man* for November, Mrs. H. G. Durai describes a game known in Tamil as *pallanguli* or 'many holes.' It is played on a board which is sometimes beautifully carved, and in which are two parallel rows of holes, varying in number, but here taken as seven. The game is played with tamarind stones, pebbles, or cowrie shells as pieces. Two players take part, one sitting on each side of the board. Six pieces are placed in each hole. The player on one side takes up six pieces from one hole on his side and begins to play by placing one piece in each hole, proceeding round the board counter-clockwise. When all six pieces have been deposited, he picks up the pieces from the next hole and proceeds as before until he ends next to an empty hole. Then he captures all the pieces in the hole next the empty one, and his move ends. If he deposits his last piece in a hole next to two empty holes he captures nothing. The move then passes to the opponent. The round ends when all the pieces have been captured in the manner described, and the next begins by the players replacing their captured pieces in the holes, each on his side of the board, six at a time. If either player has not enough pieces to fill any one or more of the holes, a leaf or piece of rubbish is placed on this 'rubbish' hole, which may, however, be filled again at a later stage of the game by recaptured pieces. When in the course of play empty holes are refilled and the number of pieces reach the number four, this is known as *pasu*, a cow, and the pieces are taken by the player on whose side is the hole. The game ends when one of the players has not enough pieces to fill even one hole at the commencement of a round. In South India this is principally a women's game, but it is played by men for gambling purposes. It bears a close resemblance to games played in Africa. Mrs. Durai's note is illustrated by reproductions of *pallanguli* boards from both India and Ceylon, the Indian board of ivory, those from Ceylon of wood carved, one of them in the form of a fish.

DUTY AND INTEREST.—The inaugural lecture recently delivered at Oxford by Prof. H. A. Prichard in connexion with the White's chair of moral philosophy, and now published by the Clarendon Press, deals with the subject of 'duty and interest.' A careful analysis is made of the way in which philosophers have treated the question of whether we perform an act of duty for the sake of advantage, either our own or the community's, or for some other reason. The attitudes of Plato and Butler are followed by that of Green, who found himself confronted by those who were influenced by the growth of physical science, and contended that for a *theory* of ethics there should be substituted a *science* of ethics. In pointing out the line that Green should have taken against his opponents, Prof. Prichard maintains that our moral convictions imply for their explanation the prior existence of the corresponding capacity on our part, which only becomes actualised given the appropriate stimulus.

MORTALITY AMONGST HOUSE-SPARROWS.—In view of the importance of the house-sparrow as a pest in corn-fields and in gardens, any factor that makes for its increase or decrease is of economic interest. The extraordinary disappearance of this species in Fair Isle, and in the Shetlands, has been described by Rear-Admiral J. H. Stenhouse in a recent issue of the *Scottish Naturalist* (p. 162). Formerly, about eight hundred sparrows lived on Fair Isle, a small islet between the Orkney and Shetland Islands, made famous by the bird migration observations of Dr. Eagle Clarke and the author of this paper. In September 1926 the number had decreased to forty, by May 1927 it had fallen to ten breeding pairs, and in April 1928 only four pairs were to be seen. From the mainland of Shetland comes the same tale of disappearance. From Sumburgh in the extreme south, from Bressay and Mid Yell, in all of which sparrows were formerly abundant, reports have been received of the gradual or total extirpation of the species. The reports indicate that the mortality is due to some disease which is manifested in swollen heads and bulging eyes, but, so far, attempts to obtain specimens for pathological examination have been unsuccessful.

INVESTIGATION OF MUTILLID WASPS.—No. 143 of the *Bulletin of the United States National Museum* (1928) is a bulky publication of more than 350 pages with 5 plates, and its author, Mr. Clarence E. Mickel, of the University of Minnesota, has produced a monograph which should prove of great value to all students of the family. It is estimated that 3500-4000 species of these insects have now been described and they are included in about a hundred genera, but their true classification is still very obscure, and this is largely due to lack of knowledge of their biology. Part I of this *Bulletin* is devoted to a discussion of what is known concerning the habits of Mutillidæ. All the species are believed to be parasites, but the hosts of only 39 of them have so far been discovered. The most usual hosts are various bees and wasps, but in a few cases beetles of the genus *Clythra* or tsetse flies (*Glossina*) are utilised. The host appears to be attacked in the prepupal or pupal stage: the female Mutillid penetrates the cocoon or puparium, as the case may be, with its ovipositor and deposits an egg either on the host or on the inner wall of the cocoon. The young larva devours the host, becoming fully

grown in a few days, when it spins its cocoon within that of the host. Part 2 of the *Bulletin* consists of a reference catalogue of type species of the genera of Mutillidæ, and Part 3, which forms the greater bulk of this publication, is a revision of the North American species of the genus *Dasymutilla*. At the end there is a very complete bibliography of the whole family, including about six hundred references.

ALIMENTARY AND RESPIRATORY SYSTEMS OF *CALAMOICHTHYS*.—Mr. G. Leslie Purser (*Trans. R. Soc. Edin.*, vol. 56, pt. 1, No. 4; 1928) concludes his account of the alimentary and respiratory systems of the Ganoid *Calamoichthys calabaricus*. He remarks on the lack of unanimity with regard to the exact application of the names applied to the parts of the alimentary canal posterior to the pharynx, and suggests definitions of the main divisions of the canal as a contribution to a clearer and more exact nomenclature. The so-called stomach of *Calamoichthys* is only partially lined by a typical gastric mucosa, the remainder having a lining resembling that of the œsophagus. For a composite organ of this kind, partly œsophageal and partly gastric, he suggests the term œsogaster. In the same way the post-pyloric portion of the alimentary canal is termed simply the intestine, there being no histological differentiation into large and small intestines as in the tetrapod vertebrates. The author describes four types of cell in the intestinal lining, and comparisons with other lower vertebrates make it appear that *Calamoichthys* has a more complex mucosa than any of the others. This difference is attributed to the refinements of modern technique rather than to the absence of one or other of the cellular elements in other types, it being probable that these elements are present, but earlier workers, lacking modern facilities, have failed to recognise them. The musculature of the wall of the alimentary canal is less developed than in any other described lower vertebrate.

CONTROL OF CANADA THISTLE.—Canada thistle (*Cirsium arvense*) is reported as being effectively reduced by means of chlorates, under conditions in which other herbicides failed to effect a clearance (Åslander, *Jour. Agric. Res.*, 36; 1928). The underground parts of the weed were killed by the application of 200 kgm. per hectare of sodium chlorate, or 250 kgm. potassium chlorate, used as dry salt on the ground during the winter. This dressing had no injurious effect on the oats sown during the next season. Spring applications were, however, less efficient in killing the thistles. The effectiveness of chlorates is due to their rapid penetration through soil and their slow rate of decomposition, especially at low temperatures. Other herbicides fail because they do not comply with one or both of these two conditions. Sodium thiocyanate decomposes too rapidly, sodium cyanide does not seem to penetrate the soil under field conditions, while sodium arsenite penetrates very slowly. The rate of penetration of the herbicides was determined by a specially constructed apparatus. Autumn applications of herbicides had no influence on the ammonification and nitrification processes in the soil during the following spring.

UNUSUAL FEATURES IN THE CYTOLOGY OF POLLEN.—From the description given by K. Piech (*Bull. Internat. de l'Acad. Polonaise des Sciences et des Lettres*. Ser. B, Sciences Nat. (Bot.) Jan. 1928) the development and gametogenesis in the pollen grain of *Scirpus* presents several unusual features. In the pollen mother cell at the close of the reduction and succeeding nuclear divisions, the usual four nuclei are present, but only one pollen grain is formed, and three of these nuclei degenerate and remain encapsuled in a 'callose-like' accumulation in the thickened wall. The generative nuclei develop in the pollen grain, and the first division to form the generative cell shows peculiar features in that in the anaphase, the phragmoplast, that characteristic appearance between the re-forming daughter nuclei which precedes the deposition of the new cell wall, becomes curved around the generative nucleus as a sort of spherical phragmoplast or 'phragmosphere.' In this way a generative cell is separated off *within* the cytoplasm of the pollen grain, and this remains separated from the rest of the pollen cell in later developmental stages by a special plasma layer. The generative cell also divides within the pollen grain to give rise either to two sperm cells (*Scirpus palustris* L.) or to two naked sperm nuclei (*S. lacustris* L.).

GEOLOGY OF THE HIGHLAND BORDER.—The rocks and structures along the Highland Boundary Fault, the northern limit of the Central Valley of Scotland, have given rise to some of the most fascinating problems of British geology. During the last few years Dr. D. A. Allan has been working the belt from Tayside to Noranside, and his results, beautifully illustrated and accompanied by a one-inch map of more than 130 square miles, are now published in the *Trans. Roy. Soc. Edin.*, vol. 51, Pt. 1, No. 3, 1928. A new exposure of the Highland Border Series has been mapped, and, though no fossils were detected, the rocks closely resemble lithologically the Jasper and Chert Series which elsewhere are known to be about Upper Cambrian. A careful re-investigation of the serpentine belt shows that visible junctions against the Lower Old Red Sandstone are everywhere fault planes. The serpentine intrusions clearly date from pre-Lower Old Red Sandstone times. The Lintrathen porphyry, previously thought to be an intrusion, is now found to be a lava-flow of typical dacite. On account of its widespread extension it is a valuable key horizon in mapping the Lower Old Red Sandstone. In subdividing the latter it has been found possible to employ the units of the classification adopted by Dr. R. Campbell in his work on the Old Red Sandstone in Kincardineshire. The Highland Boundary Fault is shown to be a steeply inclined reversed fault. It probably began as a monoclinal flexure slightly overfolded from the north-west; fracture took place along the more or less vertical limb of the fold, and the rocks to the north overrode those to the south, thus concealing part of the succession.

EROSIVE ACTION OF FLOOD WATER.—The bursting of the dams in the Porth-Llwyd valley, North Wales, in November 1925, gave opportunities for studying the effect on the topography of the erosive action of flood waters of a known volume. Prof. W. G. Fearnsides and Mr. W. H. Wilcockson deal with this subject in a paper in the *Geographical Journal* for November. A report on the subject was also presented to the British Association in 1927 by a committee appointed for the purpose. The flooding between the Llyn Eigiau reservoir and the Coed-ty dam was done by a maximum flow of 20 million cubic feet of water per hour in a channel never more than 5000 sq. ft. in sectional area. On slopes of less than 1 in 20 there was no appreciable erosion. On a slope of 1 in 15 the river entrenched its bed 10 or 12 ft. deeper into boulder clay, and trundled down its bed thousands of tons of boulders up to five tons in weight. Below Coed-ty dam the flow was for a time reinforced by 12 million cubic feet an hour, and the rate of flow increased to a maximum of 30 million cubic feet an hour. As the slope steepened to 1 in 8 and 1 in 6, the

only blocks which survived within the track were blocks larger than ten-foot cubes. On a slope of 1 in 4 to 1 in 2, every projecting block not *in situ* was rooted out and swept away.

TIME LAG IN THE PHOTOELECTRIC EFFECT.—According to an investigation described by E. O. Lawrence and J. W. Beams in the September number of the *Physical Review*, photoelectrons start to leave a potassium hydride surface less than 3×10^{-9} sec. after light starts to fall upon it. The delicate time control that was needed to establish this result was obtained by operating the different parts of an apparatus by means of electric pulses travelling away from a spark gap along wires, the disturbance reaching two successive places with a time interval equal to the difference in the wire paths to them, divided by the velocity of light. In this case, two of the wires passed to compensated electro-optic Kerr cells which were set up between crossed Nicol prisms, which served to produce a transitory flash of light lasting for about 10^{-8} sec., whilst a third lead controlled the potential of the active surface of the photoelectric cell which was exposed to the flash. It is a curious fact that the greatest source of trouble in these experiments was again the occurrence of high frequency oscillations, both in the photoelectric cell, which was a three-electrode device, and elsewhere. This investigation has incidentally demonstrated directly for the first time the extraordinary steepness of the front of the potential wave which is initiated by a spark, only about 5×10^{-9} sec. being taken for half of it to go past a point six metres along the wire.

A THERMAL PROPERTY OF MATTER.—In the *Rendiconti della Reale Accademia delle Scienze dell' Instituto di Bologna* for 1926 (recently received), Prof. Majorana describes experiments which, made with the object of obtaining evidence supporting his hypothesis of gravitational absorption, have revealed a curious thermal property of matter. Certain substances, in particular lead and iron, are found to be capable of exhibiting, in relation to the surrounding medium, thermal superelevations which depend on the previous treatment of the substance and are not in accord with the well-known laws of the progressive cooling of bodies. Use was made of a highly efficient thermostatic arrangement which admitted of the temperature being maintained constant to within about one-thousandth of a degree for a month or more. In a typical experiment, two pieces of lead, one of which had been fused just prior to the commencement of the experiment, whereas the other had not been melted for a considerable period, were cooled for an hour in the same running water and then introduced into two similar small cylindrical Dewar vessels. These were inserted in the thermostat, and the temperatures of the metals observed by means of sensitive constantan-copper or constantan-iron thermoelectric couples. A temperature difference between the two pieces of metal was revealed immediately, this becoming constant after two or three days, when the block recently fused had a temperature higher by 0·02° or 0·03° than that of the other. The difference in temperature gradually diminished in amount and, after the lapse of ten days or more, vanished completely. This phenomenon is regarded as due to a progressive emission of thermal energy by matter after being heated to any marked degree.

NEW ZEISS EPIDIASCOPE.—The increasing use of projection screen illustrations in class teaching and lecturing has been encouraged by the production of easily portable and moderately priced epidiascopes. These may be used not only for the projection of the ordinary lantern slide but also for illuminating and projecting upon the screen the image of an opaque object, and thus the necessity for making lantern slides is in many cases obviated. Several novel features which modern practice in the use and manufacture of projection apparatus has shown to be desirable are embodied in a new model, the Zeiss Ikon epidiascope. The silver-surfaced reversing mirror necessary for episcopic projection is totally enclosed in the lamp house, and is therefore protected from dust, and the possibility of its being damaged is diminished. The illumination is obtained from a specially designed 500-watt lamp. The size of the illuminated aperture is 6½-in. square, and the stage, which is adjustable, permits of the accommodation of objects up to 3-in. thick. In order to obtain an image of sufficient brilliance upon the screen, a lens of a large working aperture is necessary, and the Zeiss Ikon instrument is fitted with an anastigmat of aperture F/3·7 and focal length 14½ in. The position of the lamp and the condenser lens can be instantly changed, and the instrument used for lantern slide projection. A useful attachment, embodying a microscope objective of about 1⅓-in. focus fitted with a heat-absorbing screen, may be fitted into the tube in place of the usual lantern objective. By its means microscopic slides can easily be projected, the slide being held in position by a pair of spring clips which form part of the attachment. The London distributors of Zeiss Ikon epidiascopes are Messrs. Sands, Hunter and Co., Ltd., 37 Bedford Street, Strand, W.C.2.

HEAT OF SOLUTION OF FINELY GROUND SODIUM CHLORIDE.—It was recently found by Lipsett, Johnson, and Maass, that finely divided sodium chloride had a heat of solution different from that of the coarsely ground salt. The finely divided salt was prepared by sublimation, and the difference in the heat of solution was attributed to the energy bound up in its surface. The results were used to calculate the surface energy of solid sodium chloride. In a further paper in the *Journal of the American Chemical Society* for October, the same authors describe the determination of the heat of solution of pure salt finely ground in an agate mortar. The results resemble those obtained with the sublimed product, and the finely ground material has a heat of solution smaller in magnitude by about 25 cal. per mole than that of coarsely ground sodium chloride.

PHOTOCHEMICAL OZONISATION.—In the *Journal of the American Chemical Society* for October the relation of photochemical ozonisation to the question of the polymerisation of oxygen is discussed by O. R. Wulf. The formation of ozone from oxygen under pressure by radiation of wave-lengths 2070 A. and 2530 A. has been studied quantitatively by Warburg, who concluded that the primary photochemical process is the dissociation of the O_2 molecule. A consideration of electronic levels indicates that radiation of either of these wave-lengths is probably incapable of effecting the dissociation of the O_2 molecule, and hence the resulting ozonisation appears to indicate the existence of another molecular species in the gas. The absorption of light by oxygen under high pressure and in the liquid state, and the work of G. N. Lewis on the magnetic susceptibility of oxygen under these conditions, indicate the presence of O_4 molecules to a considerable extent. It is therefore suggested that, at the wave-lengths used by Warburg, the absorbing molecule is O_4, which dissociates into O_3 and O, and his results are discussed from the point of view of this theory.

Records of Oceanographic Work in Japan.

UNDER this title the National Research Council of Japan has commenced the publication of a journal dealing with physical and chemical oceanography, fundamental marine biology, and fisheries technology. In the first number—March 1928—an account is given of the work done by the Imperial Marine Observatory and the Imperial Fisheries Institute, with well-equipped research vessels of 125 and 200 tons respectively, and of the new Marine Biological Station at Asamushi.

This station was completed in July 1924, with the aid of a government grant, as a marine station of Tôhoku University. It is now becoming a centre for the promotion of biological science in Japan.

Research workers and post-graduate students from other institutions are welcomed and provided with laboratory facilities to prosecute their own researches. In addition, living accommodation is obtainable either in a boarding house or in one of several residences attached to the station, the visiting investigator having only to defray the cost of meals. The list of papers which have already been published shows that the opportunities afforded have attracted workers on varied biological problems.

The buildings consist of an aquarium room with a number of tanks, a range of laboratories, including rooms equipped for physiological and biochemical research, while an additional large biochemical laboratory is now under construction. A unique feature of the station is a building half submerged in the sea at the shore line, the floor being about 6 feet below sea-level. Three aquaria along one wall are supplied with natural sea water, which is continuously being changed with the ebb and flow of the tide. Since the temperature and other conditions are quite similar to that of the open sea, animals can live under practically normal conditions.

The Japanese government is far-sighted in fostering biological research by providing these facilities in one of the most delightful summer resorts, so that the staff of their universities and other institutions may continue their researches during the summer vacations under pleasant conditions and without expense.

Investigations concerning the principles controlling life, such as are prosecuted every summer by visiting workers at marine biological stations, as Woods Hole in the United States, Plymouth in Great Britain, and elsewhere, are yielding results of widening interest. Thus the attention of physiologists is turning to the possibility of attacking many fundamental problems by experiments upon the tissues of simple marine animals—a method of attack which is leading towards the interpretation of the results of investigations which have hitherto been chiefly limited to land vertebrates. The great advances in knowledge which have increased the amenities of life during the past century, have usually arisen from such investigations of purely academic interest. To attract those relatively few individuals, usually engaged in teaching at the universities, who are capable and willing to carry out such original research during their vacations, is a worthy aim for any government, for thereby the community as a whole is likely to benefit—as it has benefitted already from the fruits of 'purely academic' research. Furthermore, it is economy, in the true sense of a much-used term, to utilise fully the resources of a country's scientific learning.

A list of papers and reports bearing on oceanography and published during 1927 shows that this subject is now receiving considerable attention in Japan, which is actively participating in the International Committee for the Oceanography of the Pacific, founded to carry out similar liaison work to the International Council in the North-Western Atlantic. Other countries taking part are the United States and Australia, where the building of a marine biological station is under consideration.

Surface Actions.[1]

G. I. FINCH AND J. C. STIMSON.—The electrical condition of hot surfaces during the adsorption of gases. Part 2. When a nickel sheet is heated *in vacuo* or in contact with a gas it becomes electrically charged. The magnitude of the charge depends upon the temperature of the metal and its previous history of heating. At 850° C. the charge due to O_2, $2CO + O_2$, $2H_2 + O_2$, CO_2, H_2O, H_2, A and N_2 could be removed within 45 minutes by evacuation to less than 10^{-5} mm. On the other hand, the carbonic oxide charge could only be removed by 'burning off' with oxygen. The charge on nickel oxide *in vacuo* is the same as that on reduced nickel. Oxygen or hydrogen is far more active in charging the surface than either argon or nitrogen.

It is concluded, *inter alia*, that (*a*) the charge on a hot metal surface in contact with a gas is due to an activation of adsorbed gas molecules; (*b*) there are at least five different kinds of adsorption of a gas on a hot surface, ranging from a purely physical, electrically neutral adsorption or condensation to a definite stable chemical compound formation which is likewise electrically neutral.

P. C. ALLEN AND C. N. HINSHELWOOD.—The catalytic decomposition of gaseous acetaldehyde at the surface of various metals. Experiments have previously been made to compare the kinetics of simple homogeneous reactions, such as the decomposition of nitrous oxide, with the corresponding catalysed reactions. In continuation, the catalytic decomposition of a more complex substance, acetaldehyde, the homogeneous decomposition of which is bimolecular, has been investigated. Electrically heated wires of gold, platinum, platinum-rhodium alloy and tungsten were used as catalysts.

The reaction at the surface of each of these metals involves two molecules of acetaldehyde, but for initial pressures of more than 150 mm. tends to appear unimolecular owing to the saturation of the surface with adsorbed molecules. The mechanism suggested for the reaction is that molecules from the gas phase react with molecules adsorbed on the surface, when these latter molecules acquire the necessary energy of activation from the metal atoms.

A remarkable and unusual similarity is found between the different metals in respect of (*a*) relation between reaction rate and pressure, (*b*) heat of activation, and (*c*) absolute rate of reaction. This would have suggested that the reaction really occurred in a zone of heated gas, were it not for the evidence that surface saturation controls the rate of reaction. The aldehyde adsorption is evidently of a loose, non-specific kind. The hot wire does not appreciably modify the stability of the adsorbed aldehyde molecules (the heat of activation being nearly the same as for the homogeneous reaction), but merely acts as

[1] Abstracts of papers read before the Royal Society on Nov. 1.

a source of energy. Examination of the molecular statistics of the reaction indicates that collisions between molecules from the gas and adsorbed molecules are inelastic, with a duration of 10^{-6} to 10^{-8} sec.

R. CHAPLIN.—The sorption of carbon tetrachloride at low pressures by activated charcoals. A detailed description is given of the apparatus and experimental technique by means of which the low-pressure sorption isothermals of pure carbon tetrachloride vapour on charcoal, in the absence of foreign gases, were determined. The pressures were measured by means of a Pirani hot-wire gauge; the quantities sorbed were determined by direct weighing. Various difficulties were encountered, due to the presence of traces of foreign gases and vapours in the charcoals and in the apparatus. Six charcoals of varying origin were employed. The pressure limits worked between were $2\cdot3 \times 10^{-1}$ and 1×10^{-4} mm. of mercury. Most work was done at 25° C., but several series of isosteres were also obtained, which permitted of the indirect determination of isothermals at higher temperatures.

Stream-flow.[1]

H. LEVY AND A. G. FORSDYKE.—The steady motion and stability of a helical vortex. The characteristics of a right helical vortex are investigated as regards steady motion and stability. The steady forward motion along, and uniform rotation about, the axis is calculated for various angles of pitch; a critical pitch exists, at which this rotation vanishes. An examination of the possible fundamental modes of vibration of the filament suggests further that this critical pitch marks the division between stable and unstable helices. The results are of importance in connexion with the extension of the Kármán vortex street to three-dimensional motion.

R. J. CORNISH.—Flow in a pipe of rectangular cross-section. The paper contains the results of an investigation into the flow of water in a pipe of rectangular cross-section 1·192 cm. by 0·402 cm.

In the region of laminar motion the flow corresponded closely with that expected by calculation. The effect of the distance between the entrance to the pipe and the point at which pressures are measured is shown, and later in the paper is a note on the conclusions of Messrs. Davies and White (*Proc. Roy. Soc.*, May 1928) from their observations of this effect. The critical value of mS/v (where m = hydraulic mean depth, S = average velocity, v = kinematic viscosity) is about the same for the rectangular section as for a circular section; the effect of the proportions of the channel on the critical value is deduced. In the region of turbulent flow the curve obtained by plotting $R/\rho S^2$ (where R = resistance per unit area, ρ = density) against mS/v is approximately the same as that obtained by other workers on pipes of various sections.

Appendix 1 gives the actual numerical results of the experiments, and appendix 2 contains an outline of the mathematical solution of laminar flow in a pipe of rectangular section.

A. T. DOODSON.—The analysis and prediction of tidal currents from observations of times of slack water. The problem of obtaining harmonic constants for the principal tidal constituents representing the current flow, from a knowledge of the times of slack water only, has been solved. The solution is not one of great exactness, but resulting predictions have been considered sufficiently accurate to be included in standard tide tables. The times of maximum current can be predicted, but the velocities of maximum currents can only be stated on an arbitrary scale unless a few values of maximum currents have been observed.

The method can be applied to obtain fairly good approximations to the tidal elevation at a place, for the times of high and low water, or for the times of half-tide. Two variations of the method are given, one being suitable for the discussion of observations of all slack water times during a month and the other being suitable for the analysis of observations taken during daylight for a whole year.

[1] Abstracts of papers read before the Royal Society on Nov. 1.

University and Educational Intelligence.

CAMBRIDGE.—Prof. Dean, Trinity Hall, Mr. J. F. Cameron, Gonville and Caius College, and Mr. H. Thirkill, Clare College, are among the newly elected members of the Council of the Senate. Mr. T. R. Parrington, Sidney Sussex College, has been appointed Strickland Curator in the Museum of Zoology.

The Gedge Prize for research in physiology has been awarded to Dr. W. A. H. Rushton, Pembroke College. Mr. F. H. Woodward has been elected to a fellowship at Selwyn College. A grant of £50 has been made from the Balfour Fund to Dr. S. M. Manton, Girton College, for research on the biology and development of the Syncarida.

Mr. F. J. M. Stratton, fellow and senior tutor of Gonville and Caius College, has been elected to succeed Prof. H. F. Newall in December next as professor of astrophysics.

THE following free public lectures in connexion with the Armourers and Brasiers' Company are announced: "Certain Aspects of the Solidification of Metals and Alloys," by Dr. S. W. Smith, at the Sir John Cass Technical Institute, on Nov. 28, Dec. 5 and 12, at 8.15; and "The Manufacture of Tinplate," by Dr. C. A. Edwards, at the Borough Polytechnic Institute, on Nov. 29, Dec. 7 and 14, at 5.30. No tickets will be required.

EDUCATION in India in 1925–26 is dealt with very briefly in a report issued by the Educational Commissioner with the Government of India last May. The report shows that the percentage of males under instruction in recognised institutions, although still small (6·5) increased rapidly during the ten years following 1916, when it was only 4·7. During the same period the percentage of females under instruction increased even more rapidly, namely, from 0·9 to 1·3. The cost of education is rising fast, the expenditure in 1925–26 having been 10 per cent higher than in the preceding year. Under the heading of higher education, universities show a slight decrease in the number of students, arts colleges an increase of 8 per cent, and professional colleges an increase of 3 per cent. There was a falling off in the numbers of medical, veterinary, forest, and commercial college students and of men students in teacher-training institutions. The scheme for founding a university in Rajputana was abandoned owing to the lack of support from the Native States. The report refers to the constitution of a new affiliating university at Agra, and another (the Andhra or Telugu) at Bezwada, and a project for establishing a Tamil university. Statistics of university students show a total of 96,158 in 16 universities. Calcutta, with 31,496 students, must be almost, if not quite, the largest, in point of numbers, in the world. Seventy-five per cent of the total number of students enrolled belonged to the four universities of Calcutta, Madras, the Punjab, and Bombay. An article on Indian students in Great Britain shows a notable decrease from 583 in 1925 to 390 in 1926 in the number of Indians studying in the Inns of Court. Nearly 200 were preparing for degrees or diplomas in engineering, and more than 100 were studying medicine; 147 (including 21 women) were government scholars.

Calendar of Customs and Festivals.

November 25.

St. Katharine: saint and martyr, next to the Virgin Mary the most celebrated of female figures in Christian hagiology. She was martyred at Alexandria under Maximius after this emperor had commanded a company of the ablest of heathen philosophers to dispute with her. These she converted, and they too suffered martyrdom. She was bound upon an ingeniously contrived engine of four wheels set with spikes intended to tear her to pieces when they moved, but the cords were broken asunder by the power of an angel. Hence St. Catherine's wheel and her patronage of those who use the wheel for spinning, rope spinners, and spinsters. She is also the patroness of Christian philosophers.

Though the cult was introduced late into England—in the twelfth or thirteenth century, it is thought by the Crusaders—in a short time it became widely popular. On St. Katharine's eve, Strype records, "The 24th (1556), . . . at six of the clock at night St. Katharine went about the battlements of St. Paul's Church accompanied with fine singing and great lights; this was St. Katharine's procession."

St. Katharine was especially the patroness of spinsters, hence the proverbial expression of *coiffer Ste. Catherine* to express the state of an 'old maid.' It was customary for young women to gather together for merrymaking on this day, the special form of entertainment being divination of their future state in regard to wedlock. This custom was known as 'Kathar'ning.' One charm consisted in a number of young women, not exceeding seven nor less than three, assembling in a room at eleven o'clock at night. A sprig of myrtle which had been borne in the bosom all day was wrapped in paper, and then each girl burnt nine hairs from her head, the parings of toe and finger nails, with myrrh and frankincense on a brazier of charcoal. The myrtle was fumigated over the charcoal and then placed under the head of the inquirer as she went to bed on the clock striking twelve. She dreamed of her future husband. In Ireland women used to fast all the year round on Wednesday and Saturday and on St. Katharine's day. This got them good husbands or, if they were married, a better one.

For the survival of the custom of 'Catterning' among children in the Midlands, *see* under St. Clement (Nov. 23). At Worcester Cathedral the chapter prepared a rich bowl of wine and spices, called the 'Cathern bowl,' for the inhabitants of the college and precincts. At Peterborough the tallest of the female children in the workhouse was selected as queen and adorned with crown and sceptre. Then all the children, dressed in white with scarlet ribbons, went in procession around the city, stopping at the principal residences and reciting verses in honour of St. Katharine.

St. Katharine was specially honoured by the lacemakers in Northamptonshire and Bedfordshire. In Buckinghamshire on 'Cattern Day,' the lace-makers held merrymakings, at which cakes called 'wigs'—a kind of light gingerbread with curled edges—and ale were consumed. The rope-makers of Woolwich Arsenal had a procession very similar to that of the smiths on St. Clement's two days previously, in which a female represented 'Her Majesty,' dressed in white, with sceptre and crown and Roman banner. The carpenters of Chatteris in Cambridgeshire held a feast on St. Katharine's day, while the carters of the Isle of Thanet used to place a small figure on a wheel on the front of their cart sheds on this day.

The importance of nuts, and more particularly of apples, as articles of diet in earlier days may be gauged from their prominence in the survivals of the customs of Hallowmas, St. Clement, and St. Katharine, and also in certain municipal customs. A feature of the 'Lawless Hour' at Kidderminster (*see* Oct. 1) was the showering of apples on the bailiff from each house he visited. At Newcastle-under-Lyme the election of Mayor on the Tuesday after Michaelmas Day (later moved to the Tuesday after Nov. 9) was accompanied by the custom of 'clouting out,' when boys visited the tradespeople in the expectation of receiving nuts and apples, for which they scrambled. The apples collected at 'souling' on Nov. 1 or Nov. 2 were used in various forms of divination and for games. They were also required for the making of 'lamb's-wool,' a bowl of hot spiced ale and roasted apples. The custom of hanging apples on strings or placing them in bowls of water and catching them with the teeth—'bobbing'—a game played on all these festival days—was responsible for the name Bob Apple Day or Bite Apple Day applied in Staffordshire to St. Clement's Day. Sometimes they were roasted on a string before the fire, stuck thickly over with cloves and allowed to fall into a vessel beneath, while set verses in honour of "Catt'n and Clement" were sung. Another method of preparation was to use oats instead of cloves, afterwards spitting the apples on a wooden skewer and dredging them over with flour.

November 30.

St. Andrew, the Apostle martyred A.D. 69 at Patræ in Achaia on a cross in the form known as decussate, *i.e.* X, which hence became his emblem. Relics of the saint were brought to Scotland in 369 and deposited at the spot where St. Andrews now stands. The saint became the patron of Scotland and of the Knights of the Golden Fleece, as well as titular saint of Russia.

The close relation of St. Andrew's Day to the beginning of Advent, a period in the Church of fast and solemn observance, marks it as a time appropriate for divination. Martin Luther refers to the custom in his country of young maidens stripping themselves naked and reciting a prayer addressed to St. Andrew in order to learn what kind of husbands they should have, and from other references the custom appears to have been widespread. The injunction of nudity as part of the ritual points to an early stratum of belief, as it is often an essential element in magic rites of a very primitive character.

It is recorded that singed sheep's heads used to be borne in procession before Scots in London on St. Andrew's Day—a custom which may be connected with the Martinmas sacrifice and slaughter of cattle and sheep. In the "Statistical Account of Scotland," it is stated that citizens of Edinburgh used to resort to Duddingston, near that city, to feast on singed sheep's heads, which were thus disposed of after the sheep from the neighbouring hills had been slaughtered and the carcases sent to market. Though a summer custom without reference to Martinmas, that feast may possibly have been the origin of the practice.

Although St. Katharine as the patron of spinners was honoured by the lace-makers of Northamptonshire, they specially regarded St. Andrew and celebrated him in a festival to which the name 'Tandrew,' or 'Tander' was given. The connexion has been conjectured to be due to the forms assumed by threads in the making of pillow-lace. The day was given up to drinking and merrymaking, and in the schools 'barring out' the master. In the evening men paraded in women's clothes and the women in those of men. Visits were paid from cottage to cottage to drink 'eldern wine,' and mumming followed.

Societies and Academies.

LONDON.

Royal Society, Nov. 15.—**S. W. J. Smith, A. A. Dee, and J. Young**: The mode of formation of Neumann bands. (1) The mechanism of twinning in the body-centred cubic lattice. A discussion of atomic movements which can occur, under the influence of transient shearing stress, in a single crystal possessing a body-centred cubic lattice. (2) The evidence that the bands are twins. The orientation of these lamellæ with respect to the matrix is determined quantitatively by means of etch-figures. (3) The movement from which the twinning results. A study of the phenomena which accompany the crossing of one band by another shows that the movement is of the kind indicated as most likely in (1).—**C. F. Elam**: An investigation of some banded structures in metal. With an appendix by G. I. Taylor. Crystals showing a banded structure similar to twins of the spinel type were found in aluminium and silver. The crystallographic relationship has been studied.—**F. H. Rolt and H. Barrell**: The difference between the mechanical and optical lengths of a steel end-gauge. A set of block gauges is optically measured by an interference method. By comparing the sum of the optical lengths with the optical length of a wrung combination of the same gauges, the average difference between mechanical and optical length of a gauge may be derived. It may be calculated for all wave-lengths greater than $0\cdot55\mu$, by the formula $(M - O) = p\lambda + t'$ where $p = 0\cdot27$, $t' = 0\cdot005\mu$, and λ is in microns. For light of wave-length $0\cdot62\mu$, $(M - O)$ is $6\cdot8 \times 10^{-6}$ inch.—**D. A. Jackson**: Hyperfine structure in the arc spectrum of cæsium and nuclear rotation. The most satisfactory method of excitation is by external electrodes, using a very high-frequency alternating current, on a tube filled with helium at about 2 mm. pressure containing a small quantity of cæsium. Lines belonging to principal series are very close doublets with nearly constant frequency differences; their origin can be explained by assuming a nuclear spin of one-half quantum.—**A. Fowler and E. W. H. Selwyn**: Further investigations of the spectrum of singly ionised carbon (C II).—**O. W. Richardson and F. C. Chalklin**: The soft X-ray levels of iron, cobalt, nickel, and copper. All the well-established soft X-ray inflections for iron above 48 volts, as well as two below, have been accounted for. A similar scheme applies about equally well to cobalt and nickel, and possibly, but not so well, to copper.—**H. Jeffreys**: On aerofoils of small thickness. Existing methods of determining the flow around an aerofoil of infinitesimal thickness and the forces on such an aerofoil have been extended to cover the general case where the thickness and camber are both small but neither of them negligible.—**G. I. Taylor and C. F. Sharman**: A mechanical method for solving problems of flow in compressible fluids. An analogy between the irrotational flow in two dimensions of a fluid of variable density and the flow of electricity in a conducting sheet of variable thickness is developed. A shallow tank with a bottom of paraffin wax holds a shallow layer of copper sulphate solution serving as a conducting sheet. Any given distribution of thickness could be obtained by cutting the wax bottom. Applying the method to the flow of air past a circular cylinder, it appears that when the speed of the cylinder is as much as half that of round, the flow past it cannot be irrotational.—**A. S. Eddington**: A symmetrical treatment of the wave equation. Dirac's linear wave equation represents one special choice of matrices. Much of the general theory is obtained more simply and symmetrically by employing only commutative and other general properties of a 'perpendicular' set. An apparently more fundamental way of reaching the wave equation is to take the observed invariance of proper-mass of electron. This new wave equation corresponds to two electrons with opposite spin.—**T. H. Havelock**: The wave pattern of a doublet in a stream.—**A. T. Price**: A mathematical discussion on the structure of wood in relation to its elastic properties. The observed elastic anisotropy of wood can be explained in detail by the fact that wood is built up of long hollow cylinders, of which the majority are arranged parallel to the grain and the remainder are grouped into bundles extending radially. The annual layers appear to have little influence on this elastic anisotropy. The non-elastic slipping at stresses much lower than those usually associated with elastic failure, observed in tests involving longitudinal shearing, possibly occurs between thick-walled cells and between medullary rays and adjacent cells, and also as gross slip in the layers of weak spring-wood tissue.—**E. J. Williams, J. M. Nuttall, and H. S. Barlow**: The special distribution of photoelectrons produced by X-rays. The photoelectron emission from oxygen and nitrogen due to absorption of X-rays of wave-length $0\cdot54$, $0\cdot61$, and $0\cdot71$ A. respectively, as observed by the Wilson cloud-expansion method, shows: (1) Spread or dispersion of the photoelectrons may be satisfactorily represented by the $\cos^2\theta$ law, and (2) longitudinal asymmetry, if distribution corresponds to an average forward momentum of photoelectrons, about 40 per cent greater than that of an absorbed quantum.—**L. W. Nordheim**: The effect of the image force on the emission and reflection of electrons by metals. In thermionic emission the average reflection amounts only to a few per cent. For the intense field emission the image force reduces the value of the field strength calculated by Fowler and Nordheim by a factor about $0\cdot8$.—**W. G. Kannuluik and T. H. Laby**: The thermal and electrical conductivity of copper crystals at various temperatures. Thermal conductivity of copper is $0\cdot989$ cal. cm. sec. deg. at $19\cdot4°$ C., $1\cdot054$ at $-73\cdot7°$ C., and $1\cdot131$ at $-174\cdot8°$ C. At $19\cdot4°$ C. it is about 4 per cent greater than that of polycrystal copper, while at the lower temperatures it is considerably less. Electrical conductivity of single crystal is the same as that for ordinary polycrystal.—**H. D. H. Drane**: Elastic constants of fused quartz. Change of Young's modulus with temperature. The modulus increases continuously with rise in temperature between $-183°$ and $700°$ C., showing no minimum value which would correspond to the minimum volume exhibited by fused quartz at $-80°$ C. For a given increment of temperature the increase in modulus is more rapid at lower temperatures. Differing samples of quartz show slight variations in behaviour, and semi-permanent changes in the modulus at room temperature have been observed after heating above $400°$ C., due to fact that fused quartz is not ordinarily a single phase of silica.

(To be continued.)

Linnean Society, Nov. 1.—**V. S. Summerhayes**: Revision of the Australian species of *Frankenia*. Among the most important characters for taxonomic purposes are the arrangement and number of ovules, and the nature of the leaves. Niedenzu divided the genus into two subgenera—*Afra* and *Oceania*—and the latter, containing the Australian species, into the sections *Toichogonia* and *Basigonia*, but a series of ovular arrangements leading insensibly from *Toichogonia* to *Basigonia* has been found. The genus *Frankenia* actually seems to be composed of a number of parallel evolutionary series progressing from the

'toichogonial' to the 'basigonial' stage. The genus seems to be an ancient one, which in Australia has found favourable conditions, producing many species there. Western Australia appears to be the original home of the genus in the continent.—**Helene E. Bargmann**: Morphology of the central nervous system in the Gastropoda Pulmonata. There are eight types into which the Pulmonate nervous system can be divided, according to the degree and mode of concentration of the visceral ganglia. Variation in the type of nervous system takes place within families and within genera, but variation within species is slight and not enough to affect the combination of the ganglia as a whole. Grouping based on the nervous system, compared with groupings based on systematic classification, shows that affinities are by no means well understood.—**T. L. Prankerd**: Specificity in graviperception. Upwards of 2000 experiments have been made on the fronds of seven species of ferns in order to determine quantitatively their reaction to gravity at different stages in their ontogeny. The results are expressed as curves, termed *graviscripts*, which naturally fall into two groups corresponding to the two genera—*Asplenium* and *Osmunda*—into which these species have long been grouped on morphological grounds. Response to stimulus thus affords criteria of taxonomic value. *Osmunda cinnamomea*, which will under certain conditions respond to a stimulus lasting only twenty seconds, is the most sensitive plant to the force of gravity known.

Society of Public Analysts, Nov. 7.—**Julius Grant**: The determination of small quantities of antimony in the form of stibine. An improved form of apparatus of the electrolytic Marsh type is described, by the use of which antimony is completely and rapidly removed from its solution in 0·5 *N* hydrochloric acid, in the form of stibine, by means of a swift stream of hydrogen bubbles impinging on the point of an inverted cone lead cathode. Small quantities of antimony (10 to 0·001 mgm.) have thus been determined in alloys, ores, rubber, etc., in the presence of other metals.—**E. Lester Smith**: The determination of unsaponifiable matter in oils and fats. In most methods the extraction of unsaponifiable matter is incomplete (80 to 98 per cent), and hydrolysis of dissolved soap while washing the ethereal extract may result in fatty acid being weighed with the unsaponifiable matter. Two methods in which these errors are avoided are described.—**Paul Arup**: The composition of Irish butter. There is no marked tendency for the volatile acids to be associated with oleic groups in preference to the stearic and palmitic groups; the acid groups seem to be impartially distributed among the different glycerides.—**H. B. Dunnicliff**: The volumeric determination of mercury. The method is based on the reduction of mercuric chloride solution by means of stannous chloride in the presence of sodium tartrate in an atmosphere of carbon dioxide.

PARIS.

Academy of Sciences, Oct. 1.—**G. Bigourdan**: The coordinates of the Observatory of the rue de Paradis. Deduced from data in notes by Delambre.—**G. Charpy** and **P. Pingault**: The conditions of formation of cementite. The carburation of solid iron by potassium cyanide or by hydrocarbons tends to form cementite, at least for temperatures up to 1000° C.—**Georges Claude**: The production of power by steam passing between two masses of water.—**Serge Bernstein**: The growth of polynomials.—**E. Huguenard, A. Magnan**, and **A. Sainte-Laguë**: An experimental determination of the polar of an aeroplane and of a bird in flight.—**Léon** and **Eugène Bloch**: The spark spectra of selenium and tellurium: The use of the oscillating electrodeless discharge separates clearly the spark lines of the first order of sulphur and selenium from those of higher order. The same method has also been applied to tellurium.—**André Job** and **Jean Rouvillois**: The preparation of a tungsten carbonyl through the intermediary of an organo-magnesium compound. Carbon monoxide is absorbed by a mixture of tungsten hexachloride and phenyl magnesium bromide. Crystals of tungsten carbonyl, of the composition $W(CO)_6$, can be isolated from the products of the reaction.—**Mlle. L. Remy**: The influence of the fertilised ovule on the tissues of the fruit.—**A. Guichard**: The origin, direction, and torsion of the inverse fibro-vascular bundles of *Claudium Mariscus*.—**Rodolphe Dostál**: The reproductive organs of *Caulerpa prolifera*.—**A. Guillaumin**: The storage of seeds in a medium deprived of oxygen as a means of prolonging their germinating faculty. It has been proved in a previous communication that seeds kept in a good vacuum retain their germinating power longer than when exposed to the air. It is now shown that an atmosphere free from oxygen has a similar effect in prolonging the vitality of seeds.—**Wünschendorff** and **Ch. Kilian**: Observations on the metabolism of *Ustulina vulgaris*. The cultures contain ammonia, amino-acids, urea, and creatinine, but neither indol, aldehydes, nor acetone. In the presence of carbohydrates, acids (oxalic, lactic, citric, malic) are formed.—**J. Bordas** and **P. H. Joesse**: The reducing action exercised by fungi of the genera *Fusarium* and *Verticillium*, parasites of the wood vessels.

LENINGRAD.

Academy of Sciences. *Comptes rendus*, Nos. 20-21.—**F. Loewinson-Lessing**: What is dunite? Two types of dunite must be distinguished: dunites, strictly speaking, which are olivines, or olivine-serpentines with chromite; and enstatitic dunites, in which there is more than 5 and up to 25 per cent of enstatite.—**G. Vereschagin**: Preliminary consideration on the origin of the Baikal fauna. Up to 1925 there were recorded from Lake Baikal 725 species of plants and animals, but recent expeditions of the Academy added more than 600 forms, including more than 300 belonging to new species, genera, and even families. Geological evidence tends to show that the greatest depths of the lake developed probably only in the Quaternary period, and this is corroborated by the fact that all deep-water animals of the lake are closely allied to those living nearer the surface and are little specialised. Faunistic elements in the lake are as follows: widely distributed Siberian forms; ancient fresh-water forms dating back probably to the Tertiary period; marine forms, which must be regarded as relics of the former connexion with the ocean; and forms of uncertain origin.—**N. T. Fedorov**: An adjustment of Glan's spectrophotometer for investigations in physiological optics.—**V. Emelin** and **G. Zeiss**: The control of trypanosome infection in camels in Russia. The trypanosomiasis of camels is widely distributed in Russia, and two species of trypanosomes have been recorded in connexion with it, namely, *Trypanosoma ninæ* Kohl-Jakimova and *T. su-auru* Ilovajski. Bayer's preparation 207 proved to be effective against all species of trypanosomes. Blood-sucking flies (*Tabanus*, *Chrysops*, and *Hæmatopota*) are considered as mechanical carriers of the trypanosomes.—**M. Serebrennikov**: A synopsis of Russian squirrels. There are ten subspecies of *Sciurus vulgaris* L. and one subspecies of *S. anomalus* Gm. in the Russian fauna. Short diagnoses and the distributions of all of them are given.—**N. M. Kulagin**: Contribution to

the study of moulting in the White Sea seal (*Histriophoca grœnlandica* Lepechin). Histological study of hairs and the epidermis of moulting seals.—N. Kusnezov: *Oligamatites martynovi*, gen. et sp. n., a fossil Amatid Lepidopteron from the Oligocene beds of Central Asia. Re-examination of original descriptions of all reputed fossil Noctuids leads to the conclusion that they are all based on very doubtful examples; thus, the insect described in the present paper is the first unquestionable fossil Noctuid known, and also one of the very few incontestable fossils of the order Lepidoptera. The first authentic Lepidoptera are found not earlier than in the lower Tertiary, and the representative of the family Amatidæ described also belongs to that epoch, although the family is unanimously recognised as one of the most specialised ones.—A. Vasiliiev: The accuracy of triangulations in the Spitsbergen meridian measurements.—Z. Nemova: Determination of minerals in the *volkanic tchernozem* of the volcanic lava fields in Armenia. Mineralogical analysis of volcanic black soils of Armenia.—M. Neibourg: The materials collected by the Ashutas expedition of the Geological Museum of the Academy. The expedition to the Ashutas Mountains at the Mongolian border brought back more than seventy species of fossil plants, 14 species of fossil insects and other palæontological material.—A. Formozov: The desert elements in the fauna of South-Eastern Europe. Many species of animals belonging to the Aralo-Caspian desert fauna are distributed westwards from the Volga and reach northern Caucasus, while many of them extend even farther westwards. Numerous examples are given, and it is suggested that detailed studies of the fauna of xerothermic habitats in South-West Russia will increase their number.

Official Publications Received.

BRITISH.

Melbourne Observatory. Hourly Values of the Magnetic Elements at Toolangi, in 1926. Observed and reduced under the direction of Dr. J. M. Baldwin. Pp. vii+41. (Melbourne: H. J. Green.)

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June 1928. Pp. 221. (Melbourne.)

Records of the Geological Survey of India. Vol. 61, Part 2. Pp. 147-206+plates 2-20. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Echinoderma of the Indian Museum, Part 10. An Account of the Echinoidea. By Prof. René Kœhler. 8: Échinides réguliers. Pp. 158+27 planches. (Calcutta: Zoological Survey of India.) 25 rupees.

Memoirs of the Indian Museum. Index, Vol. 8, 1924–1928. Pp. iv+xvi. 10 annas; 1*s*. Vol. 9, No. 1. Pp. 27+4 plates. 2 rupees; 3*s*. 6*d*. (Calcutta: Zoological Survey of India.)

Records of the Indian Museum. Vol. 29, Appendix: List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1927. Pp. xix. 1 rupee. Vol. 30, Part 1, April. Pp. 145+3 plates. 2.12 rupees; 5*s*. Vol. 30, Part 2, July. Pp. 147-215+plates 4-7. 2.12 rupees; 5*s*. (Calcutta: Zoological Survey of India.)

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1927–8. Pp. 54. (London: The Crown Agents for the Colonies.) 5*s*.

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 13, Parts 3 and 4. Pp. 145-351. (Cambridge: At the University Press.) 15*s*.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1927. Part 2. Pp. iv+110+4 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Proceedings of the Cambridge Philosophical Society. Vol. 24, Part 4. Pp. 471-609+viii. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fifth Conference held at New College, Oxford, September 14th-17th, 1928. Pp. 136. (London.) 5*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 9: A Synthesis of 5′:7:2′:4′-Tetrahydroxyflavone and of 7:2′:4′:6′-Tetrahydroxyflavone. By Dr. Nicholas Michael Cullinane, Dr. Joseph Algar and Dr. Hugh Ryan. Pp. 77-83. 6*d*. Vol. 19 (N.S.), No. 10: The Estimation of Diphenylamine and Diphenylnitrosamine in the Presence of their Derivatives. By Dr. H. Ryan, Dr. J. Keane and J. Dunne. Pp. 85-100. 1*s*. Vol. 19 (N.S.), No. 12: The Commercial Utilisation of Java Citronella Oil. By Dr. Brendon O'Donoghue, James Drum and Dr. Hugh Ryan. Pp. 113-120. 6*d*. Vol. 19 (N.S.), No. 13: The Action of Alcoholic Hydrochloric Acid on Methyldiphenyltetrahydropyrone. By Dr. Hugh Ryan and Dr. J. J. Lennon. Pp. 121-124. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Journal of the Chemical Society: containing Papers communicated to the Society. October. Pp. iii+2631-2829+x. (London: Gurney and Jackson.)

India Meteorological Department. Catalogue of Exhibits displayed at the Opening of the New Headquarters Office at Poona on 20th July 1928, together with an Introductory Note on the Work of the Department. Pp. 16. (Poona.)

Report on the Administration of the Meteorological Department of the Government of India in 1927–28. Pp. 14+4 plates. (Simla: Government of India Press.)

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1927–28. Pp. 42. Examination Lists, August 1928. Pp. 35. (London.)

Board of Education. Report of the Consultative Committee on Books in Public Elementary Schools. Pp. xxi+162. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

FOREIGN.

Sudan Notes and Records. Vol. 10, 1927. Pp. iv+251+28 plates. (Khartoum.) 30 P.T.; 6*s*.

Proceedings of the American Academy of Arts and Sciences. Vol. 63, No. 3: The Petrology of the North Conway Quadrangle in the White Mountains of New Hampshire. By Marland Billings. Pp. 67-137+2 plates. 1.20 dollars. Vol. 63, No. 4: Studies on the Fauna of Hot Springs in the Western United States and the Biology of Thermophilous Animals. By Charles T. Brues. Pp. 139-228+6 plates. 1.60 dollars. (Boston, Mass.)

Rubber Research Institute of Malaya. Planting Manual No. 2: The Budding of Hevea in Modern Plantation Practice. By F. Summers. Pp. iii+100. (Kuala Lumpur, F.M.S.) 2 dollars.

Pisma Marjana Smoluchowskiego z polecenia Polskiej Akademji Umiejętności. Tom Trzeci. (Œuvres de Marie Smoluchowski, Tome 3.) Pp. v+349. (Krakowie: Uniwersytetu Jagiellońskiego; Paris: Ch. Béranger.)

United States Department of Agriculture. Circular No. 45: The Application of Sodium Fluosilicate by Airplane in an Attempt to control the Sugar-Cane Moth Borer. By T. E. Holloway, W. E. Haley and J. W. Ingram. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 3, September. Pp. 297-485. (Washington, D.C.: Government Printing Office.) 25 cents.

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 158-159: Über das Krötengift. Von Munio Kotake. Mitteilung 1: Die Zusammensetzung des chinesischen Arzneimittels "Senso"; Mitteilung 2: Die giftigen Bestandteile des Sekretes der japanischen Kröte Bufo (bufo japonicus). Pp. 99-115. 25 sen. No. 160: On the Stark Effect of Helium. By Yoshida Ishida and Genji Kamijima. Pp. 117-140+plates 3-5. 45 sen. No. 161: On the Stark Effect of Lithium. By Yoshida Ishida and Masaichi Fukushima. Pp. 141-150+plates 6-7. 25 sen. No. 162: The Crystal Structure of some Rhombic Formates. By Isamu Nitta. Pp. 151-163. 20 sen. No. 163: Relations between Carbon, Hydrogen and Oxygen Contents, in Cotton Cellulose under Thermal Decomposition, and its Weight Loss. By Takeo Akahira. Pp. 165-180. 25 sen. (Tōkyō: Iwanami Shoten.)

Annalen van de Sterrewacht te Leiden. Deel 15, Tweede Stuk: A Catalogue of 1073 Stars in the Zone of North Declination 55° to 60°, observed in the Years 1926 and 1927, together with a Discussion of the Differences with the A.G.C. Helsingfors. By C. H. Hins. Pp. 43. (Leiden.)

Proceedings of the United States National Museum. Vol. 74, Art. 5: Fossil Footprints from the Fort Union (Paleocene) of Montana. By Charles W. Gilmore. (No. 2750.) Pp. 4+3 plates. (Washington, D.C.: Government Printing Office.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 21, Part 5: Zweiter Beitrag zur Ichneumoniden-Fauna Japans. Von Toichi Uchida. Pp. 177-297+3+3 Tafeln. (Tokyo: Maruzen Co., Ltd.)

Bulletin of the American Museum of Natural History. Vol. 58, Art. 2: A Synopsis of the Mutillidæ of the Belgian Congo. By J. Chester Bradley and J. Bequaert. Pp. 63-122. (New York City.)

CATALOGUES, ETC.

The Cambridge Bulletin. No. 61, October. Pp. 32+8 plates. (Cambridge: At the University Press.)

Calendar for 1929. (London: British Museum (Natural History).)

Diary of Societies.

FRIDAY, NOVEMBER 23.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 2.30.—R. H. Stoughton: The Relation of Environmental Conditions to Angular Leaf Spot Disease of Cotton.—Dr. W. F. Bewley: The Effect of Environmental Factors on Diseases under Glass.—T. Small: Temperature and Humidity in Relation to *Cladosporium fulvum*.

ANATOMICAL SOCIETY OF GREAT BRITAIN AND IRELAND (Annual Meeting) (in Anatomy Department, King's College), at 3.—J. H. Mulligan: Complete Absence of Corpus Callosum in Human Brain.—Prof. C. J. Patten: The Mechanism involved in the Technique of Bird Utterances.—Dr. A. B. Appleton: An Example of the M. Cervico-costo-humeralis (Gruber).—C. P. G. Wakeley: A Note on the Architecture of the Ilium.—Dr. R. J. Gladstone: The Origin of the Vena Azygos Major.—Dr. V. E. Negus: The Function of the Cartilage of Santorini.—Dr. F. W. R. Brambell: Histology of the Gonads of an Hermaphrodite Pig.—Dr. D. M. Blair: Note on Submaxillary Lymph Glands.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Dr. H. M. M. Mackay: Nutritional Anæmia in Infancy—Some Observations on a Common Deficiency Disease.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. G. Temple: The Physical Interpretation of Wave Mechanics.—A. Monkhouse: The

Effect of Superimposed Magnetic Fields on Dielectric Losses and Electric Breakdown Strength.—A. Campbell: A New A.C. Potentiometer of Larson Type.—Prof. E. F. Herroun and Prof. E. Wilson: Ferromagnetic Ferric Oxide.—Demonstration by R. H. Humphry of Emulsions showing Chromatic Effects.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. C. H. S. Evans: Searchlights and their Applications.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with Manchester Association of Engineers) (at Manchester), at 7.—R. Brooks: Electric Traction on Railways.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Tornblad and Mitchell: Hartmann Spiral Bricks.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—C. F. Moore: A Survey of Cadmium.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—R. Brooks: Electric Traction on Railways.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN (Birmingham Area) (at Chamber of Commerce, Birmingham), at 7.30.—F. H. Boden: Bearings.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. H. Newsholme: Individuality and Epidemic Disease.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.

SATURDAY, NOVEMBER 24.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. C. Whittaker: North Country Folk Music (II.).

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.30.—Dr. M. Culpin and Miss May Smith: The Nervous Temperament: Its Incidence, Measurement, and Expression.

MONDAY, NOVEMBER 26.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School, Cambridge), at 4.30.—Work in Progress at, or in Connexion with, the Low Temperature Research Station:—Sir W. B. Hardy: Introductory Remarks.—F. Kidd and C. West: A Mass Experiment with Apples.—Dr. T. Moran, J. R. Vickery, and E. C. Smith: (*a*) The Freezing of Gels; (*b*) Critical Temperatures; (*c*) Muscle Proteins.—Dr. A. J. Smith: Transport Problems; the East Malling Station, its Design and Equipment.—Dr. J. Barker: The Covent Garden Market Survey.—R. G. Tomkins: The Effect of Temperature and Humidity on Spore Germination.

INSTITUTE OF ACTUARIES, at 5.—R. Thodey: Life Insurance in Australia.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—E. S. Ritter and others: Discussion on Picture Telegraphy.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Informal Discussion on Automatic Network Voltage-Regulating Equipments.

ROYAL SOCIETY OF ARTS, at 8.—Dr. F. Kidd: Biology and Refrigeration (Cantor Lectures) (III.).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Dr. E. W. Fish: Dead Tracts in Dentine.—Sir Frank Colyer: Irregularities of the Teeth in Erythrocebus (Patas Monkey).

TUESDAY, NOVEMBER 27.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—Col. H. L. Crosthwait: Air Survey and Empire Development.

ROYAL SOCIETY OF MEDICINE (Medicine Section) (Clinical Meeting at University College Hospital), at 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Diamonds (II.).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Informal Discussion.

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—D. F. Campbell: Electric Furnace Developments.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—S. E. Sheppard and E. P. Wightman: The Effect of Environment on Photographic Sensitivity. Part I.—S. E. Sheppard: Anti-fogging and Anti-sensitising Effects.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Section) (at Watergate House), at 7.25.—S. Miall: Petrol-electric Transmission.

SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—T. H. Turner: Fighting Corrosion.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8.30.—Sir Arthur Keith: The Evolution of the Human Races (Huxley Memorial Lecture).

ROYAL AERONAUTICAL SOCIETY (Leeds Branch).—Flight Lieut. B. C. H. Cross: Some Practical Aspects of Flying Boat Developments.

INSTITUTION OF MECHANICAL ENGINEERS (Swansea Branch—Graduates' Meeting).

WEDNESDAY, NOVEMBER 28.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Dr. W. G. Savage: Unsolved Problems of Salmonella Food-poisoning.

INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Dr. E. C. Wadlow: The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles.

ALCHEMISTS' SOCIETY (in University, Glasgow), at 7.30.—A. D. Kent: Address.

ROYAL SOCIETY OF ARTS, at 8.—J. H. Estill: The Port of London.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Film by J. M. Leonard of the Recent Canadian American Tour.

GLASGOW PHILOSOPHICAL SOCIETY (at 207 Bath Street, Glasgow), at 8.—Dr. K. G. Fenelon: Modern Industrial Tendencies.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at 11 Chandos Street, W.), at 8.30.—Dr. G. Groddeck: Psychic Treatment of Organic Diseases.

THURSDAY, NOVEMBER 29.

IMPERIAL COLLEGE CHEMICAL SOCIETY (in Chemical Technology Department), at 5.—Dr. D. M. Newitt: High Pressure Syntheses.

LINNEAN SOCIETY, at 5.—T. A. Sprague and E. Nelmes: The Herbal of Leonhard Fuchs.—Edith L. Stephens: Exhibition of Lantern Slides illustrating Some Aspects of the Natural History of the Country about Cape Town.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. D. Adrian: The Mechanism of the Nerves (II.).

BIOCHEMICAL SOCIETY—UNIVERSITY OF BIRMINGHAM (at Birmingham), at 5.30.—Dr. F. W. M. Lamb: Some Anomalies in the Metabolism of Heavy Metals, with particular reference to Iron and Lead.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. F. G. Donnan: Physical Chemistry in the Service of Biology (Liversidge Lecture).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—F. Sigrist: Production Problems.

BURNLEY TEXTILE SOCIETY (at Mechanics' Institute, Burnley), at 7.15.—Lecture on Calico Printing.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Royal Hotel, Luton), at 7.30.—E. C. Thompson: Purchasing.

INSTITUTION OF CIVIL ENGINEERS (Yorkshire Association) (at Hotel Metropole, Leeds), at 7.30.—J. Gilchrist: Some Experiments in Measuring the Strain in the Reinforcing Bars of Concrete Steel Beams.

ROYAL SOCIETY OF MEDICINE, at 9.15.—Sir William Bragg: Faraday's Diary (Lloyd Roberts Lecture).

TEXTILE INSTITUTE (Irish Section) (at Belfast).—F. Scholefield: Some Cases of Light Action in the Dyeing and Bleaching of Textiles.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Dr. H. W. Swift: Power Transmission by Belts: an Investigation of Fundamentals.

FRIDAY, NOVEMBER 30.

TEXTILE INSTITUTE (Manchester), at 1.15.—E. E. Canney: Rational Development in the Organisation of the Cotton Industry.

ROYAL SOCIETY (Anniversary Meeting), at 4.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. Dalby: The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine (Thomas Lowe Gray Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. E. V. Telfer: Frictional Resistance and Ship Resistance Similarity.

TEXTILE INSTITUTE (jointly with Leigh Municipal College Textile Section) (at Leigh), at 7.15.—W. Bailey: Various Methods of Winding Artificial Silk Yarns.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—C. W. Harvey: The Manufacture of Decorative Metal Work.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates' Branch) (at 51 West Regent Street, Glasgow), at 8.—W. P. Kirkwood: Brakes.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—W. Lind-Jackson: Napier Aero Engines.

SATURDAY, DECEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. C. Whittaker: The Violin Sonatas of William Young (17th Century).

PUBLIC LECTURES.

FRIDAY, NOVEMBER 23.

KING'S COLLEGE, at 5.30.—C. J. Gadd: Assyrian Studies in the Past.

SATURDAY, NOVEMBER 24.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Mummies.

MONDAY, NOVEMBER 26.

UNIVERSITY OF LEEDS, at 5.15.—C. N. Hinshelwood: The Laws of Chemical Change.

UNIVERSITY COLLEGE, at 5.30.—Prof. C. B. Fawcett: Some Problems of Geography.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Dr. A. G. Ruston: The Pros and Cons of Grass and Arable Farming.

UNIVERSITY COLLEGE OF THE SOUTH-WEST, EXETER, at 7.30.—Dr. P. B. Ballard: Open-Air Schools (Chadwick Lecture).

WEDNESDAY, NOVEMBER 28.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. H. M. Vernon: The Fatigue of Heavy Industrial Work, and its Influence on Health and on the Duration of Working Life.

GOLDSMITHS' HALL, E.C., at 4.30.—Prof. J. Arthur Thomson: The Culture Value of Natural History (Norman Lockyer Lecture of British Science Guild).

KING'S COLLEGE, at 5.30.—Prof. Doris L. Mackinnon: The Indebtedness of Industry to Pure Science: The Practical Applications of Zoology.

SIR JOHN CASS TECHNICAL INSTITUTE, at 6.15.—Dr. S. W. Smith: Certain Aspects of the Solidification of Metals and Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Dec. 5 and 12.)

THURSDAY, NOVEMBER 29.

BOROUGH POLYTECHNIC INSTITUTE, at 6.30.—Dr. C. A. Edwards: The Manufacture of Tinplate (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on Dec. 7 and 14.)

SATURDAY, DECEMBER 1

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Bird Life.

CONFERENCE

ON RECENT CHANGES IN SYSTEMS OF HUSBANDRY IN GREAT BRITAIN.

TUESDAY, NOVEMBER 27.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30 A.M.

C. S. Orwin: The Relative Advantages of Intensification and Extensification of Farming.

H. W. Drewitt: Recent Breaks from the Old Rotations in the Chichester District.

Col. G. H. Long: The Entry of Sugar Beet into the Economy of the Farm.

H. V. Taylor: Fruit and Vegetables as Adjuncts to the Farm.

SATURDAY, DECEMBER 1, 1928.

CONTENTS.

Science and the Public.

THE occasion for another article on a familiar subject is the Prime Minister's inaugural address to the University College of Wales, Aberystwyth, on the contributions of science and statesmanship to the problems of civilisation. Mr. Stanley Baldwin makes no claim to the title of 'man of science.' One hopes that he possesses what in political circles are known as the 'best brains.' If he does, he would be the last to proclaim the fact. But he does possess in a high degree that Greek quality which Matthew Arnold translated as "sweetness and light," and that Roman virtue extolled by the dying Antoninus Pius, *aequanimitas*. Apart from his official position, anything he says on the relations of science to the public will be heard with respect.

Learning, Mr. Baldwin told the Aberystwyth students, is less aggressive than it was fifty years ago, because scientific men realise more the limitation of their own work. The world of knowledge, like a particle of radium, is in a state of rapid dissolution. Mr. Baldwin admits that with his "slow working mind" he no sooner begins to understand an accepted explanation than it is obsolete. This fills him with discouragement. His mind is not nourished by the débris of discredited theories, which is spoon-fed to the public. There is no finality. "We cannot catch up with knowledge," Mr. Baldwin says. Life is like a greyhound race, without a dog's chance of catching the electric hare, running in a groove which we call "the laws of science," and controlled by another intelligence, remote, inscrutable.

When Mr. Baldwin turns from knowledge to those possessing knowledge, what does he find ? Experts differ. He goes to economists for advice on safeguarding and finds that no two agree. If he seeks advice on the gold standard, the experts reply with different voices. Generalisations or ghostly abstractions are offered to him instead of practical advice. But, as he says, politicians have to deal with men, swayed by good or bad passions, by ignorance, and ignorance played upon, not with figments of the imagination such as "the economic man."

This is a well-worn theme on which happy warriors have contended in innumerable college common rooms and other places where they argue. Happily, as George Eliot observed, the blessed work of helping the world forward does not wait to be done by perfect men—or by perfect scientific or economic theories. Men of science will agree with the Prime Minister that the methods of the physical laboratory are not the methods to be applied in dealing with human nature. But they ask—and

this Mr. Baldwin seems disposed to concede—for "some preparation of the human mind," for the new world which science is creating, not so much a concrete knowledge of science as a scientific outlook, a scientific habit of thought, or, at the worst, a conviction that there is such a subject, like the Eton boy's conviction about Latin.

On the day following Mr. Baldwin's address, Mr. J. B. S. Haldane lectured to the Fabian Society on "Science in Western Civilisation," his thesis being that western civilisation is based on applied science and the future depends on how science is applied to human life. At present, the policy of most States is framed by politicians, carried out by civil servants and interpreted by journalists, all equally ignorant of science. Here is a counter-indictment by a distinguished man of science to the Prime Minister's charges. Mr. Haldane makes no high demands. He would be satisfied if the Cabinet contained one member with a knowledge of science equivalent to a second class in the Natural Science Tripos, Part 1, at Cambridge! Mr. Haldane gave some examples of official ignorance of science during the War. Could not the Prime Minister, without excluding from our civil departments the fine flower of the "grand old fortifying classical curriculum," take steps to ensure that every Government office contains men of scientific training and attainment?

Mr. Baldwin, with curious prescience, observed in his address that professors of biology apparently think they are the elect of the earth. Not less than 50,000 original contributions on that subject are published every year, he said. Biology is an entrancing subject and Mr. Haldane is doing a good service, "one stroke of faithful work," in emerging from his laboratory and discontinuing for a space his vivisection experiments—on himself—in order to make suggestions on scientific lines for curing the world's evils. Incidentally he gave an illustration in support of the Prime Minister's argument that men of science are not always in agreement among themselves. Eugenists, after some years of discussion, were able to convince the Government that it was wise to promote "good births" by income tax adjustments. Successive Chancellors of the Exchequer, including Mr. Winston Churchill, have endorsed the principle. But on this question Mr. Haldane draws opposite conclusions to Major Darwin and Dean Inge. If the restriction of families is due to a desire on the part of the parents to leave their children a modest competence and to ensure their efficient education, why not, he asks, abolish hereditary wealth and provide first-rate schools for all children? That suggestion, addressed to an audience of socialists, may have been a sop for Cerberus. We shall not expect Mr. Haldane to perform an experiment on himself to establish this thesis, in a university the life-blood of which is provided by hereditary wealth. Mr. Haldane's main argument remains—that if western civilisation is to survive, the ruling class must be scientifically educated. The election of Mr. Hoover as president of the United States, calling to this high office for the first time a man of scientific training and outlook, is a world-portent more significant, perhaps, than the Russian large-scale experiment in scientific education for which Mr. Haldane shows some predilection.

One final observation. Would it not be possible to encourage a more active appreciation on the part of the public of the benefits which science is daily conferring on the community—in the reduction of labour, in the cure of diseases, in transportation, and a hundred other aspects of human life? Consider broadcasting, for example. The British Broadcasting Corporation, by a broadcast appeal, could secure within a few hours sufficient funds for some worthy memorial, expressing the people's gratitude for the lives and labours of those men of science who have made broadcasting possible—Faraday, Clerk Maxwell, Hughes, Marconi, Lodge, Fleming, and others. The Prime Minister said that he often felt that there is a real danger of the abundance of new knowledge impeding progress, that the apparatus accumulated by the scholar will be so great that he will not be able to move. Men of science will not endorse that view. Science is the golden girdle binding the world together. With every increase of the world's gold, as Sir William Jenner said, the metal loses something of its value; but every addition to the store of scientific truth adds to its value, serving as a stepping stone to further discoveries.

> Who loves not knowledge? Who shall rail
> Against her beauty? Who shall fix
> Her pillars?

T. LL. H.

Fossils and Stratigraphy.

Stratigraphical Palæontology: a Manual for Students and Field Geologists. By Dr. E. Neaverson. Pp. xiii + 525. (London: Macmillan and Co., Ltd., 1928.) 18*s*. net.

DURING the past thirty years many deep borings have been carried out in Great Britain. Some of these have been put down to tap deep-seated water-bearing formations; others have been made in search of hidden coalfields, particularly in the east and south-east of England. Since the

formations to be sought for lie buried under a thick cover of later beds, usually presenting a different lithological facies underground from that along the outcrops, the identification of stratigraphical horizons in these rocks by means of fossils becomes a matter of great practical importance, and in this direction the studies carried out by the Geological Survey have proved of immense value to the mining engineer in Kent and in the Yorkshire-Nottingham coalfield.

We have been led to make these remarks by the appearance of Dr. E. Neaverson's volume, in which he sets forth an account of the zonal methods employed by the stratigraphical palæontologist. This is an excellent book, and one that fills what has hitherto been a distinct gap in British geological literature. The author divides the volume into two parts: in the first portion he discusses at length the morphological features of the chief fossil groups, the preservation and occurrence of fossils, the relation of fauna to habitat and the geographical distribution and migration of plants and animals. He devotes an excellent chapter to the consideration of fossils as indices of horizon. In this the author shows that the use of fossils in stratigraphy is based upon the fact that organisms show progressive change as their history is traced upwards through successive series of strata. In other words, the observed facts of evolution and faunal succession form the basis of zonal stratigraphy. Thus, where the evolution of plants and animals has taken a definite direction, and after the different stages of morphological development have been worked out in detail through successive stratigraphical horizons in one area, they can be used to correlate the sequences of sedimentary rocks in another district. Here, in other words, is the dictum of William Smith, amplified and reinforced by the conceptions of the evolutionist. The author fully illustrates these views in dealing with the graptolites and ammonites.

The second portion of the volume is devoted to a description of the floras and faunas of the geological systems, beginning with the Cambrian; and these are lucidly described and with a wealth of detail. Here and there, however, one finds oneself not in complete agreement with the author. For example, the usefulness of the chapter on Carboniferous faunas, otherwise excellent, is diminished by the somewhat curt dismissal of the faunas of the marine bands which occur at various horizons in the Coal Measures, on the ground that "they have not yet been sufficiently investigated and no generalisation can be made in respect of them." There is probably no better or more widely known stratigraphical horizon in the British coalfields than the Mansfield Marine Band. It, or its equivalent stratum, is recognised in nearly every coalfield in England or Wales, and even in Scotland it probably has its counterpart in the well-known Skipseys Marine Band. In this connexion another regrettable omission is the absence of any reference to *Listracanthus*, a notable genus of fish confined to this horizon.

In a volume of this scope and character it is scarcely surprising to find minor errors creep in. There are several, and no doubt they will be rectified in a future edition of the work. One or two only need be pointed out. On p. 368, *Ostrea discoidea* Kitchin is said to be on Fig. 55. It should read Fig. 53, but in this the authorship of the trivial name is ascribed to Seeley. Again, on p. 373, *Saccocoma* is said to be associated with *Allovirgatites*, whereas on the table on p. 374 it is shown (correctly) as being confined to the Pectinatites Zone, the horizon of the Kimmeridge Oil-shales.

On p. 382 the author states that "in these Midland counties there is a thick clay series, extending through the Callovian, Divesian, Argovian, and Kimmeridgian stages, whose differentiation is almost impossible on lithological characters and is not always easy by palæontological methods." Surely no difficulty has ever been experienced whenever fossil material was available. Again, on the same page, it is stated that "it has only recently been recognised, by the application of palæontological methods, that the upper Kimmeridge Clay (Bononian Stage) is nowhere present north of Buckinghamshire," whereas in Norfolk and Lincolnshire borings have revealed a complete sequence from the Pectinatites Zone downwards through the formation. This zone is also exposed in the cliffs at Speeton in Yorkshire.

The volume is well illustrated and contains about 500 excellent figures of fossils, mostly of zonal value. Nearly every chapter is followed by a selected list of books of reference which should prove of the utmost value to the student. One is in full agreement with the author's injunction that every student should know the history of his science. He certainly will be impressed by the achievements of the early writers, and will soon perceive that many additions to knowledge "attributed to later workers could have been credited to the pioneers had the information been originally expressed appositely."

We heartily commend this volume to the student and to the general reader.

J. P.

Newton and his Work.

Sir Isaac Newton, 1727–1927: a Bicentenary Evaluation of his Work. A Series of Papers prepared under the Auspices of The History of Science Society, in collaboration with the American Astronomical Society, the American Mathematical Society, the American Physical Society, the Mathematical Association of America, and various other Organisations. Pp. ix + 351. (London: Baillière, Tindall and Cox, 1928.) 22*s*. 6*d*. net.

"IT is with the belief that the publication of these papers will lead to a better comprehension of [Newton] . . . and to a more rational appreciation of his achievements, that the History of Science Society has arranged for the publication of this volume." With these words the president of that Society, Prof. David Eugene Smith, introduces the collection of papers read at the gathering held in New York on Nov. 25–26, 1927, to mark the bicentenary of the death of Sir Isaac Newton.

The contributions of the twelve authors are meant to appeal to the general reader rather than to those who are already familiar with one or more of the many fields in which the creative activity of Newton made its mark. The aim has been kept steadily in view, but at the same time there is much between the covers of the book that is of interest to the trained student, and one paper, dealing with the earliest disciple of Newton in America, contains much that is fresh to English readers.

Prof. D. C. Miller deals with the discoveries of Newton in optics. He makes it clear that the corpuscular structure of light rays ultimately formed part of Newton's theory, but is of opinion that the time has not yet come to assert that either a corpuscular or an ether theory, or both combined, will prevail when the tercentenary approaches. "The temptation to draw analogies between Newton's corpuscles and Planck's quanta, between 'fits of easy transmission' and waves, is confronted by difficulties so far insuperable, unless the new mechanics of Heisenberg and Schrödinger provides the necessary reconciliation." The author clearly sums up the specific contributions Newton made to optics, and adds references to what he did not do and to phenomena which he might have detected.

Prof. G. D. Birkhoff gives a clear explanation of Newton's 'philosophy of gravitation,' and briefly indicates how the accumulation of results in experimental physics led to a modified view of the physical universe and to modern relativity ideas. Prof. W. W. Campbell follows with a most interesting paper on Newton's influence upon the development of astrophysics. Newton's "views as to the nature of light seem to have much in common with those held by physicists in the last two or three years—by De Broglie, Schrödinger, and others. . . . To me it is clear that Sir Isaac Newton was uniquely the great pioneer of astrophysics." Prof. M. I. Pupin takes Newton's dynamics as his subject, and gives reasons for the hope "that a new dynamical science will soon be born, and that, like Maxwell's dynamics, it will be another daughter of Newton's dynamics." Prof. E. W. Brown's contribution is entitled "Developments following from Newton's Work," and its gist is summed up in his final words: "Newton's name runs no danger of being forgotten when his work is subjected to the acid test for all scientific work, namely, its capacity for further development."

Prof. Florian Cajori adds to his reputation by a valuable piece of research into the causes of Newton's delay of two-score years in announcing his law of gravitation. He opens with a careful study of what was known in England about the size of the earth, before the days of Picard's measurements, and gives tables of his results in a form suitable for rapid reference. Finally, having shown clear reasons for rejecting the attribution of the delay to any great error in the value for the size of the earth used in 1666, he finds the cause in "theoretical difficulties involved in the earth-moon test," thus ending with a decision in favour of the Adams and Glaisher explanation in 1887. Prof. Cajori follows this paper with a few pages on the moot question: Did Newton perform partial differentiation and deal with partial differential equations?

Prof. P. R. Heyl pays a tribute to Newton's experimental skill, and Prof. L. C. Newell dwells upon the aim Newton had in view when he applied the talents he had acquired to the problems of the chemistry of his day. In whatever field Newton laboured he remained "a philosopher, searching experimentally for a fundamental interpretation of broad relations in natural phenomena." For example, in the "De Natura Acidorum" he speculates on the operation of the force of residual affinity, and on that subject we still await a Newton "to order our knowledge with a philosophy." In his speculations on the nature of fire he went as far as was possible before the discovery of oxygen.

Mr. G. E. Roberts, a former Director of the United States Mint, contributes an interesting

sketch of Newton's work at the Mint. His office of warden, says Macaulay, "had become a mere sinecure, and had been filled by a succession of fine gentlemen who were well known at the hazard table of Whitehall, but who never condescended to come near the Tower." In the opinion of this modern financial expert, Newton proved himself to be "a financier of foresight, and one with a firm grasp of a large problem."

Finally, we have an attractive paper by Mr. F. E. Brasch, the Librarian of Congress, on John Winthrop, Newton's first critical disciple in the American colonies. John Winthrop, at the age of twenty-four years, was made professor of mathematics and natural philosophy at Harvard, and was the first to make fluxions a subject in the college course. He was the direct descendant of two Winthrops who were elected fellows of the Royal Society in 1663 and 1734 respectively. For his own work on transits of Mercury and Venus, amongst other things, he was himself elected fellow in 1766. His last communication to the Royal Society was in defence of Newton against a statement made by Castillon in his "Life of Newton."

It is interesting to learn that at the exhibition of Newtoniana held in connexion with the celebrations were shown two volumes presented by Newton himself to the Library of Yale College—the "Principia" (1713), and the Latin edition of the "Optics" (1706), for the preparation of which Dr. Samuel Clarke received £500 from the author.

Polar Geography.

(1) *Problems of Polar Research: a Series of Papers by Thirty-one Authors.* (American Geographical Society Special Publication, No. 7.) Pp. v + 479. (New York: American Geographical Society, 1928.) 5 dollars.

(2) *The Geography of the Polar Regions.* Consisting of A General Characterisation of Polar Nature, by Otto Nordenskjöld; and A Regional Geography of the Arctic and the Antarctic, by Ludwig Mecking. (American Geographical Society Special Publication, No. 8.) Pp. viii + 359. (New York: American Geographical Society, 1928.) 4 dollars.

(1) THIRTY-ONE authors, most with personal experience of the polar regions and each an expert in some branch of research, have contributed to the first of these volumes. The result is a collection of papers of the highest value, which reflects great credit on the enterprise of the American Geographical Society. There must obviously be a certain overlap among several of the papers, just as certain topics are overlooked, but this does not detract from the value of the collection.

The first paper is suitably by Dr. F. Nansen and contains a summary of his views on Arctic oceanography based largely on papers previously published in Norwegian and German. This paper contains a coloured map of North Polar regions. Other notable papers are by Sir Douglas Mawson on the unsolved problems of Antarctic exploration, Dr. E. von Drygalski on Antarctic oceanography, Dr. K. Rasmussen on future research in Eskimo problems, and Mr. V. Stefansson on the utilisation of Arctic resources. There are also several papers by Russian authors based on the work of the Russian icebreakers north of Siberia, expeditions the results of which have so far been little accessible to English students.

Biological problems are also treated at some length, and there are articles on polar flying by Comdr. R. E. Byrd, Mr. L. Ellsworth, Sir G. H. Wilkins, and General U. Nobile. Sketch maps are numerous and bibliographical notes are copious.

The volume is one of the few available, outside purely technical results, that treats polar research from the point of view of the problems to be solved with no attention whatever to heroic endeavour or sensational achievement.

(2) The second volume consists of two translations, Dr. O. Nordenskjöld's "Polarnaturen," a Swedish work published in 1918, and Dr. L. Mecking's "Die Polarländer," published in German in 1925. Dr. Nordenskjöld's book has been partly revised in translation and is based on a series of lectures. It is a valuable sketch of the main features of polar physical geography, including climate and natural history, based on the author's own wide experience in north and south.

Dr. Nordenskjöld does not attempt a full explanation of the Antarctic blizzards, but he contrasts the southerly winds on the edge of Antarctica with the outflowing winds from Greenland. The latter he describes as typical föhns, but finds that similar effects are lacking on the border of the southern continent, and suggests that the fundamental explanation of the lack of a maritime climate in the Antarctic coastal belt is due to the vastness of the ice-sheet and its dominating effect on the climate. Yet föhn effect, or winds with those characteristics, have been noted in Victoria and Wilhelm Lands, where the descent is abrupt. In the chapter on land-forms a theory of the formation of the strand flat as due to frost weathering along the edge of a shelf-ice or ice-foot is indicated but not elaborated.

In fact, Dr. Nordenskjöld's course of lectures is too short for all the valuable ideas it contains.

Dr. Mecking's book occupies the greater part of this volume. Beyond a few general chapters it is occupied with regional descriptions. It is a useful storehouse of facts enhanced by good photographs and a bibilography which is serviceable but not complete. Many minor matters would bear corrections, but complete accuracy is perhaps unobtainable in a book covering so wide an area. The statement that the polar landscape is "the quintessence of monotony in form and colour" could not have been written by anyone with a wide experience of polar regions. R. N. R. B.

History of Medicine.

A Short History of Medicine: introducing Medical Principles to Students and Non-Medical Readers. By Dr. Charles Singer. Pp. xxiv + 368. (Oxford: Clarendon Press; London: Oxford University Press, 1928.) *7s. 6d.* net.

THE numerous readers of NATURE, medical and otherwise, who are familiar with Dr. Singer's valuable contributions to the history of medicine, will welcome the appearance of this volume in which he has admirably succeeded in his attempt to trace the history of medicine as "a Rational Discipline involving many and perhaps all the sciences."

The work is divided into six chapters of unequal length, devoted respectively to Greek medicine down to the year 300 B.C., the Heirs of Greece, including the Alexandrian School and medicine in the Roman Empire, with special reference to Galen; the Middle Ages from about A.D. 200 to about A.D. 1500; the rebirth of science from about 1500 to about 1700; the period of consolidation from 1700 to 1825; and the period of subdivisions from 1825 down to the present day.

Although the author lays stress on the fact that the narration of the earlier times is so condensed that more than half the book is devoted to modern medicine, ample justice is done to the earlier workers. Not only is the debt of medicine to the Greeks and their contemporaries recognised, but also the important part played by the Romans in the organisation of medical science is emphasised, especially in departments relating to public health.

The chapter on the Middle Ages contains a description of the period of depression from about A.D. 400 to about 1200 during which all theoretical knowledge was allowed to lapse, superstitious practices crept in, and, apart from the School of Salerno, medicine surrounded by sacred associations deteriorated into a collection of formulæ. Then follows an account of Arabian medicine and the medieval awakening, in which the universities, especially Bologna, where public dissections were first performed, played a prominent part. In the revival of learning which took place in the fifteenth century and involved anatomy, physiology, and internal medicine as well as other branches of science, an important place is assigned to the anatomist Vesalius, whose masterpiece, "The Fabric of the Human Body," is regarded by the author not only as the foundation of modern medicine as a science, but also as the first great achievement of science itself in modern times, ranking with the treatise of Copernicus on "The Revolutions of the Celestial Spheres," which was published in the same year, 1543. The influence exercised on medicine in the seventeenth century by natural philosophers who were not medical men, such as Galileo, Boyle, and Newton, is illustrated by the work of Sanctorius, whose experiments laid the foundation of the modern study of metabolism, the microscopical investigators Malpighi and Leeuwenhoek, and others.

The first half of the eighteenth century was mainly occupied by two great medical figures, Hermann Boerhaave, who is described as the greatest physician of modern times and the pioneer of medical instruction in Europe, and Albrecht von Haller, one of the most voluminous of scientific writers, who won special distinction as a physiologist.

The last chapter, which occupies nearly half the book, deals with the development of preventive medicine, in which Great Britain was the leader from the first—embryology, chemical and experimental physiology, cellular pathology, the germ origin of disease, anæsthesia, modern surgical advances, bacteriology, the study of immunity, the conquest of the tropics, treatment of insanity, revolution in nursing, and medical statistics.

In the epilogue Dr. Singer deplores the lack of literary expression characteristic of a large proportion of modern scientific writers, due to the increasing neglect of the humanities in the adolescent stage of mental development.

The book is well printed, lavishly illustrated, and provided with a full index, the value of which is enhanced by the dates being fixed to the names of all persons mentioned in the text. The many readers who derive profit and pleasure from the present work will be glad to learn from the preface that Dr. Singer is engaged in a history of the biological sciences treated on somewhat similar lines.

Our Bookshelf.

The Geology of Venezuela and Trinidad. By R. A. Liddle. Pp. xxxix + 552 + 85 plates. (Fort Worth, Texas: J. P. MacGowan; London: Thomas Murby and Co., 1928.) 33*s.* 6*d.* net.

VENEZUELA is a country now of special interest both in economic and academic geology. In this volume Mr. R. A. Liddle states the facts collected in that country and Trinidad during five years' field work for an American oil company in 1920–25. The book is useful from its mass of facts, which are systematically stated and tabulated. It is illustrated by numerous sketch maps and illustrations. The author shows that the country consists of a basis of metamorphic rocks, which are covered by rare Silurian or Ordovician beds, and some Devonian. An extensive series, which he calls the Old Red Series, from its apparent age, would be more appropriately called the New Red Series. There are no marine Jurassic rocks, but a varied series of Cretaceous, which are covered unconformably by a succession of Eocene. After another unconformity and some Oligocene rocks follows the Miocene, which is described as the characteristic formation of Venezuela. It was followed by great earth movements and uplifts. The Pliocene was a period of erosion, while the Pleistocene in the southern part of the country is a vast tract of alluvium with broad sheets of outwash gravel from the Andes. The author's view that some of the garnetiferous schists are of Cretaceous age is based on evidence that appears quite inadequate. The account of the tectonic structures is not very clear. The bibliography is irregular and inaccurate. Misprints are aggravatingly numerous, but perhaps the author was unable to see proofs. There is no reference to the work of some other geologists who were engaged in Venezuela and Trinidad at the same time.

Geometrische Optik. Von Dr. H. Boegehold. (Sammlung Borntraeger, Band 11.) Pp. 375. (Berlin: Gebrüder Borntraeger, 1927.) 13·50 gold marks.

So many books have been devoted to the subject of geometrical optics—the principles of which are already well defined—it is often difficult to find much variation in the presentation of the material or justification for its republication; the illustrations have often a too familiar appearance. No charge of this kind can be brought against the "Geometrische Optik" of Dr. Boegehold. If some of the illustrations seem familiar, it is because they have been reproduced from the original works of the pioneers of optics, to whom the elucidation of the principles discussed is originally due. The author has invested a subject which usually involves laborious study with a historical interest, which makes the perusal of the descriptive portions a pleasure.

The mathematical treatment does not require any very special equipment. To some extent this is due to the extensive use of the simple trigonometrical system commonly used by manufacturers. As stated by the author, it is only in the last chapter that some difficulty may be experienced, owing to the omission of intermediate steps in the development of the formulæ. Students will find the practical examples of trigonometrical computation particularly instructive.

A feature of the work is the association with each diagram and illustration of a clear and concise description. There is provided a list of reference works, both historical and modern, together with a satisfactory subject index. J. W. F.

Manuel du relieur. Par J. Lemale. (Bibliothèque Professionnelle.) Pp. 350. (Paris: J. B. Baillière et fils, 1927.) 22 francs.

THIS is a clearly written book by a high authority on practical bookbinding, suitable for amateur or professional. It does not enter into either mass binding or casing for the trade, or the refinements of finishing dear to the high-class amateur. The attempt to illustrate the various manual processes by photography might perhaps have been more successful had the photographs been better reproduced in the printing; as they are, they are less clear than the line drawings in Mr. Cockerell's well-known book.

For English readers, who presumably would be either bookbinders or bibliographers, the most useful parts of the book are likely to be the glossary of technical terms, and the French names for the various sizes of paper and the measurements of the corresponding formats. The diagram explaining the terms applied to the various regions of a bound book is good and clear.

Flandern. Von Prof. Dr. Wilfried von Seidlitz. (Die Kriegsschauplätze, 1914–1918, geologisch dargestellt, in 14 Heften, herausgegeben von Prof. Dr. J. Wilser, Heft 8.) Pp. viii + 82. (Berlin: Gebrüder Borntraeger, 1928.) 10·40 gold marks.

THE exorbitant charge of 10·40 gold marks for this paper-bound pamphlet of 82 pages, with a dozen crude figures in the text, is probably due to some sale being assured as part of a series which contains some important works. The book is a useful summary of the geology of Flanders, and includes an instructive table (pp. 14-15) of the Belgian Kainozoic deposits. The book refers to the military engineering in the War, and to the victory at Messines having been achieved by the British mining having, unnoticed and unheard, deposited a million kilograms of explosive 20 metres below the lowest German counterworks.

Criminology. By Horace Wyndham. (Benn's Sixpenny Library, No. 27.) Pp. 79. (London: Ernest Benn, Ltd., 1928.) 6*d.*

THIS small book on criminology is a very interesting and well-composed account of the history of crime mainly in Great Britain. The conditions described even so recently as a hundred years ago will make many people's hair stand on end, and show how urgently penal reform was needed, and, for that matter, still is needed. The author, like many people of the present day, considers that capital punishment should be abolished.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Tidal Bore in the Trent.

THE accompanying photograph (Fig. 1) which was taken by me on Aug. 18 last at Knaith, five miles above Gainsborough, conveys an idea of the appearance of the tidal bore in the River Trent. Gainsborough is the most convenient stopping place for the visitor who desires to witness one of the most striking phenomena in the natural scenery of Great Britain. It is a sight which never palls, and at each high spring tide a group of residents gather on the bank at Gainsborough and at every village for twelve miles down the river. Visitors from distant parts of the country are, however, scarce, and this, I think, is largely owing to want of guidance as to dates when the display can be reckoned on with certainty.

FIG. 1.—Tidal bore in the River Trent at Knaith.

Sufficient information can be gleaned from the table of the time of high water at certain ports which appears on the fourth page for each month in "Whitaker's Almanack." Days when very high tides are expected at London Bridge are marked with an asterisk, and on these days 'a good eagre' is expected in the Trent. The hour of high water at Hull is given on the same page, and this is the time when the visitor should take station on the riverside path below the end of Bowling Green Road, Gainsborough. It must be remembered that the time given in "Whitaker's Almanack" is G.M.T., so that one hour must be added for the months when Summer Time is in operation. The earliest and latest hours are approximately 6 A.M. and 9 P.M. G.M.T. From April to September inclusive there is enough light to see both morning and evening eagre. March and October are good for height of tide, but light is failing in the evening, and from November to February, both inclusive, conditions are unfavourable for the spectacle.

On the occasion of my latest visit to the Trent I arrived at Gainsborough on Aug. 16, the day after new moon, and saw the eagre on this and three following days. Morning and evening I met the eagre some miles below Gainsborough, and as soon as it had passed I motored to a point higher up the river and met it again, and so on as far as Torksey, ten miles above Gainsborough. The near view is splendid, from the fury of the waves lashing the bank, and the foaming 'whelps' which rear their crests above the shallows. The distant view, less easy to obtain in this flat country, is almost equally striking in a different way, the whole disturbance merging in one broad bright band extending from bank to bank which sweeps majestically up the river. The length of course run by the eagre is fully five-and-thirty miles from its beginning near the outfall into the Humber estuary, and all the way the coming of the tide is heralded by the warning cry 'ware eagre.'

VAUGHAN CORNISH.

Inglewood,
Camberley, Surrey.

Absolute Magnitude Effects in Stellar Spectra.

IT is known from the fundamental work of Adams and Kohlschütter and their followers that certain pairs of lines in stellar spectra change in relative intensity with absolute luminosity, and this has formed the basis of the method of 'spectroscopic parallaxes.' The method has been hitherto empirical, stars of known luminosity being used as a basis to determine the luminosities of other stars from calibration curves. Saha's researches on high-temperature ionisation, whilst not removing the empirical basis, afforded a general qualitative explanation of many of the results observed. They showed that the lowered value of surface gravity g in giant stars as compared with dwarfs must cause reduced pressures in the atmospheres of giants with consequent increased ionisation and hence increased intensity of enhanced lines (Pannekoek, *B.A.N.*, 19).

Certain anomalies, however, remained. The Balmer lines, for example, have been long known to increase in intensity in giant stars, whilst, originating as they do from neutral atoms, they should on the simple theory decrease. Again, the lines of Sr^+ always increase in intensity with increasing luminosity, whilst on the simple theory they should decrease at temperatures above the temperature-maximum in the stellar sequence. Lastly, Miss Payne (*Harvard Bulletin*, No. 307, 1927) has found that the lines of all neutral atoms increase in intensity with increasing luminosity, in opposition to the predictions of the simple theory.

In a paper recently communicated to the Royal Astronomical Society, I have developed a method for treating stellar absorption lines taking account of the optical depth at which they originate—more precisely, of the optical thickness τ_0 of the layer in which they originate. It is found possible to define a depth $\tau=\tau_0$ such that the behaviour of the N atoms between $\tau=0$ and $\tau=\tau_0$ determines the behaviour of the corresponding spectral line. The value of τ_0 depends on the part of the line-contour concerned, being greater in the wings than in the centre, but it is quite determinate. The method lends itself to the discussion of absolute magnitude effects, and it is found possible to calculate dN/dg at constant temperature, τ_0 constant.

If dN/dg is negative, the line should increase in intensity as g decreases, that is, from dwarfs to giants; and vice versa if dN/dg is positive. In calculating dN/dg two alternative assumptions may be made: either we may take κ, the coefficient of general absorption of the stellar atmosphere, to be constant, or we may attribute opacity to photoelectric processes and put $\kappa = aP/(kT)^{9/2}$ according to the calculations of Kramers and Eddington, a being a universal constant, T the temperature, and P the electron pressure.

If κ is taken as constant, the sign of dN/dg is found in every case to be in accordance with the qualitative predictions of the simple Saha theory; for neutral atoms we find $dN/dg > 0$, which is, however, in contradiction with observation. But if we take $\kappa = aP(kT)^{9/2}$, dN/dg is found to be negative. This is in agreement with observation. Thus observation decides against the assumption κ = constant and in favour of the physically acceptable law $\kappa = aP/(kT)^{9/2}$. The origin of this marked difference resides in the differing behaviour of P_0, the partial electron pressure at the constant optical depth τ_0, on the two assumptions.

The strontium anomaly is similarly removed when we take $\kappa = aP/(kT)^{9/2}$. Whether the observations confirm the values of dN/dg in amount as well as in sign cannot be stated until more detailed spectro-photometric determinations of line-contours are available for sequences of stars of constant T but differing g. The theory predicts, however, that the Balmer lines should be much more sensitive to g in stars of low effective temperature than in the earlier types, as appears to be the case.

The new formulæ, if confirmed by observation on stars of known g, will afford a method of comparing the g-values of any two stars of the same temperature, and so ultimately give a rational basis to the determination of spectroscopic parallaxes. The possibility of thus determining g-values from line-intensities was pointed out some years ago by Pannekoek.

Full details will be communicated to the Royal Astronomical Society.

E. A. Milne.

The University, Manchester,
Nov. 15.

Vortices on the Monsoon Front.

The south-west monsoon advances in most years from the south-east Arabian Sea first towards Malabar and then gradually northwards along the west coast of the Indian Peninsula with a clear discontinuous boundary, the monsoon air being relatively cool, moist, and highly unstable, and the air on the other side hot, dry, and less unstable. It has been known to move northwards in some years with a well-marked 'depression' in front, a few hundred miles in diameter, and cause a burst of the monsoon on the west coast, but it was never recognised that innumerable little whirls, 20-30 miles in diameter, formed on the discontinuous boundaries, and passed undetected, except those which left their traces in the Colaba autographic records. Even at Colaba they were unknown until two very typical vortices passed through Bombay on June 17, 1927, and forced attention to their existence. A search was made of the past records, and several others were discovered to have passed through Bombay in previous years. They were looked for during the burst of this year's monsoon, and a feeble one was noticed passing through Bombay shortly after midnight on June 11.

The monsoon fronts undoubtedly represent typical discontinuities in the tropics analogous, though not quite similar, to the polar fronts in the extra-tropical region, the theory of which has been so elaborately developed by the Norwegian meteorologists. The vortices formed on the monsoon fronts are therefore of peculiar interest; for, when the detailed synoptical investigations of the fronts are available, they will eventually be found to be waves as well as vortices like those on the polar fronts (V. Bjerknes, *Geofysiske Publikationer*, vol. 2, No. 4), and thus throw considerable light on the nature of the transition layer between the different air masses.

Assuming that the vortex, which passed through Bombay between 7 and 8.30 A.M. on June 17, 1927, had travelled with the velocity of the mean wind which prevailed before and after its passage, it would appear that it had a diameter of about 22 miles. The sharp rise in wind velocity from 15 to 57 miles per hour, followed by a sharp fall to 12 miles and another sharp rise to 48 miles, and then a quick return to normal condition, all occurring within an hour and a half, during which the direction changed from south to north through west, and pressure dropped by 0·173 inch of mercury, suggest that the centre of the vortex must have passed within 2 or 3 miles of the Observatory. The velocity distribution in this vortex can be very approximately represented by that of a Rankine's combined vortex. A velocity of 50 miles per hour in its ring of maximum velocity will thus account for a central barometric depression of 0·19 inch of mercury. In a similar manner the observed barometric depression in the other vortices which passed through Bombay could be explained by working out a theoretical vortex having approximately the observed distribution of velocity. There can thus be very little doubt that all of them had the structure of an atmospheric vortex.

The air temperature near the ground during the passage of the vortex of June 17, 1927, dropped from 79·5° F. to 77·3° F. This vortex was followed by another after about 14 hours, and the temperature again dropped, from 79·7° F. to 76·5° F. The succession of vortices, some well defined and others not so well defined, which passed through or near Bombay in this year, and also in some previous years, during the northward movement of the monsoon fronts along the west coast, lends strong support to the view that they are also waves on surfaces of discontinuity. A detailed account of these vortices will be published in due course.

S. K. Banerji.

The Observatory, Bombay,
Oct. 17.

The interesting letter of Dr. S. K. Banerji on the appearances of vortices at Bombay before the arrival of the monsoon is based for its theory on a fairly strict acceptance of V. Bjerknes' view that a cyclone is a product merely of dynamical instability of Helmholtz waves on a widely extended front between cold and warm air. But many still accept the earlier view, due to Dove, Helmholtz, Margules, Bigelow, Exner, and others, that a cyclone merely requires the juxtaposition of two air-masses at different temperatures, the latent heat of condensation providing energy in addition to that from the descent of the centre of gravity of the system when the cold air flows under the warm. The conventional statement regarding the area in front of the oncoming monsoon when disturbed was that it is one 'of squally weather in which a storm may be forming'; and the corresponding explanation was that at first light variable airs prevailed there for two or three days, so that the air near the sea surface became very hot and moist, conditions favourable for instability.

I welcome Dr. Banerji's letter, however, for its reminder of the temperature contrast between this

hot moist air and the cool air of the moist monsoon current, so that when the monsoon wind advances under the heated air we shall have the essential conditions of a cold front with its attendant squalls and its tendency to produce the vortices of waterspouts. It will facilitate the production of rain if the hot air which is lifted by the cold is moist, at any rate in its lower layers; and it may be that cyclones only form when this moisture exceeds some limit. Also it would be interesting to see whether the direction of the front between these two air-masses is related with the direction in which the cyclone, when formed, begins to move—a matter on which light is badly needed. GILBERT T. WALKER.

The Heat of Dissociation of Nitrogen.

IN a recent letter to NATURE (122, 313; Sept. 1, 1928) E. Gaviola has presented some evidence indicating that the heat of dissociation (D) of N_2 is not more than 9·8 volts, as contrasted with the 11·4 volt value calculated by Birge and Sponer (*Phys. Rev.*, 28, 259; 1926). It seems desirable to state that some months ago R. S. Mulliken and I independently reached the conclusion that the value of D for N_2 is probably about 9·5 volts. The evidence on which I reached this conclusion, which seems to me quite direct and unambiguous, is contained implicitly in a recent article by G. Herzberg (*Ann. d. Physik*, 86, 189; 1928) on the negative N_2 bands.

Herzberg has greatly extended this system, obtaining 12 levels in the excited state (A'), as compared to the 5 levels available to Birge and Sponer. He is thus able to get a fairly trustworthy curve for the variation of the frequency of vibration with the vibrational quantum number (p. 205, loc. cit.). He then obtains, from this curve, 3·5 volts as the probable value of the heat of dissociation for this excited (A') level, with 3·7 volts as an upper limit. However, plots made by me of all known vibration curves indicate that they probably always have a point of inflection, and the true value of D for level A' is therefore slightly more than 3·7 volts, rather than

For a reason appearing below, I will assume 3·9 volts as an upper limit. Adding the electronic energy 3·2 volts, one obtains 7·1 volts as an upper limit for the total energy difference between the normal (X') level of N_2^+ and dissociation from state A'. If the products of dissociation from state A' are two normal atoms (N^+ and N), then 7·1 volts is also, within a few tenths of a volt, the normal heat of dissociation (D') of N_2^+. If the products of dissociation from state A' include one excited atom, D' is at least 2·4 volts *less* than 7·1 volts. By the argument presented below, this would give $D = 9{\cdot}5 - 2{\cdot}4 = 7{\cdot}1$ volts, an unreasonably low value. The probable products of dissociation from the various electronic levels are discussed in the accompanying letter by Prof. Mulliken.

The total energy necessary to obtain normal N^+ and N from normal N_2 is then given by either $I_m + D'$ or $D + I_a$, where I_m and I_a are the respective ionisation potentials of the neutral molecule (N_2) and neutral atom (N). Hence, by conservation of energy, $I_m + D' = D + I_a$, a relation used repeatedly by Birge and Sponer. I_m can scarcely be more than 16·9 volts (the experimental values range from 16·3 to 16·9 volts). We have just seen that D' can scarcely be more than 7·1 volts. Hence $7{\cdot}1 + 16{\cdot}9 = 24{\cdot}0$ volts, giving an upper limit for the potential at which N^+ ions might first appear, starting with normal N_2. Hogness and Lunn (*Phys. Rev.*, 26, 786; 1925) observed N^+ ions at a minimum potential of 24 volts. Considering now the right side of the equation, we know that I_a is 14·5 volts (J. J. Hopfield, *Phys. Rev.*, 27, 801; 1926). Hence D cannot well be greater than 9·5 volts.

This new value of 9·5 volts (or a few tenths of a volt less) is consistent with Sponer's theory of the origin of the α-group bands observed in the afterglow of active nitrogen, provided that one assumes that association to form the nitrogen molecule occurs only between one normal and one 2·4 volt (metastable) excited atom. It is also consistent with the quite different recent ideas on this subject given by Kaplan and Cario (NATURE, 121, 906; June 9, 1928). This, however, is a matter which can more appropriately be discussed by those actively at work in the field.

Birge and Sponer used the value of D for N_2 in calculating indirectly the value of D for NO. The above lowering from 11·4 to 9·5 volts lowers the D of NO by half this difference, the new indirect calculation being thus 7·3 volts (or less). This agrees better with the later more reliable direct calculation of 6·8 volts, by Jenkins, Barton, and Mulliken (*Phys. Rev.*, 30, 150; 1927). All recent work seems to indicate the approximate correctness of the value 7·0 volts for the D of O_2, given by Birge and Sponer. Hogness and Harkness (unpublished work) have recently checked the Birge and Sponer value of about 11 volts for CO. The probable values for the heat of dissociation of these molecules are therefore, in the opinion both of Prof. Mulliken and myself, O_2, 7·0 volts; CO, 11 volts; N_2, 9·5 volts (or slightly less); NO, 7 volts.

RAYMOND T. BIRGE.

University of California,
Sept. 28.

IN connexion with the assignment of quantum numbers for electrons in molecules (R. S. Mulliken, *Phys. Rev.*, 32, 186; 1928), it is important, in considering a molecule in a specified electronic state, to know in what electronic states the atoms or ions resulting from its adiabatic dissociation would be (R. S. Mulliken, *Phys. Rev.*, November 1928). I have thus been led to a study of dissociation products and heats of dissociation for various molecules, and among other results have reached conclusions essentially the same as those stated in the accompanying letter by Prof. Birge. Only a few points concerning the nitrogen molecule will be given here; further discussion will be found in the articles cited.

As Prof. Birge points out, data on N_2^+ furnish strong evidence for a value of about 9·5 volts for the heat of dissociation (D) of neutral N_2. Three electron levels of N_2^+ are known at present, namely, two ^2S levels at about 16·9 and 20·1 volts (X' and A' levels of Birge), and a third, probably also ^2S, level at 24 volts, which is known from the work of Hogness and Lunn. The transition $A' \longrightarrow X'$ corresponds to the 'negative nitrogen bands.' If we confine ourselves to a consideration of adiabatic processes of dissociation, definite theoretical limitations exist in regard to possible dissociation products. Thus, as Hund has shown (*Z. f. Physik*, 42, 93; 1927), an unexcited (^4S) N atom and an unexcited (^3P) N^+ ion can give only *one* ^2S state of N_2^+ on adiabatic union. Other ^2S states must involve an excited atom or ion.

As Birge notes in the accompanying letter, Herzberg's work leads to the conclusion that the best experimental value for the total energy ($T.E.$) required to ionise an N_2 molecule, excite it to state A', and dissociate it adiabatically, is (not more than) 24·0 volts. This value leads to $D = 9{\cdot}5$ volts, if the dissociation products of state A' are an unexcited atom and ion. If the latter supposition is correct, the dissociation products from the *normal* state X'

of N_2^+ must then, according to the preceding paragraph, include an *excited* atom or ion. Assuming a ^2D excited N atom and an unexcited ion, we have $T.E. = 24{\cdot}0 + 2{\cdot}39 = 26{\cdot}4$ volts for dissociation from state X', 2·39 volts being the energy interval between the low ^4S and ^2D states of the N atom. The observed value of $T.E.$ for state X', as obtained by Birge and Sponer by linear extrapolation of the ω_n curve, is 26·0 volts. Experiment and theory are therefore in excellent agreement if $D = 9{\cdot}5$ and if, as Herzberg has suggested, unexcited N_2^+ gives $N^+ + N'$ (N' indicates N excited to the ^2D state), while excited N_2^+ in state A' gives $N^+ + N$ (unexcited), on adiabatic dissociation.

The following table shows how the $T.E.$ values compare with values calculated according to each of the assumptions $D = 9{\cdot}5$ and $D = 11{\cdot}8$ volts. The agreement is good only if $D = 9{\cdot}5$. If the assumed dissociation products for states X' and A' are reversed, the agreement is very poor for D equal to *either* 9·5 or 11·8.

Electron Levels.		Total Energy to Excite and Dissociate (Volts).		
Designation.	Volts.	Observed.	Calculated.	
			$D = 11{\cdot}8$	$D = 9{\cdot}5$
$X'(^2S)$	16·9	26·0	28·7($N' + N^+$)	26·4($N' + N^+$)
$A'(^2S)$	20·1	24·0	26·3($N + N^+$)	24·0($N + N^+$)
Hogness and Lunn (^2S?)	24	> 24	28·7($N' + N^+$), or higher	26·4($N' + N^+$), or higher

In the case of Hogness and Lunn's 24-volt level, $T.E.$ for adiabatic dissociation is doubtless at least 26 volts. The energy of 24 volts becomes available, however, in *collisions*, and suffices in these circumstances for dissociation into $N^+ + N$. This fact is in good agreement with $D = 9{\cdot}5$, but is incompatible with $D = 11{\cdot}8$.

A study of experimental data on $T.E.$ values in relation to theoretically possible dissociation products for the electron levels of *neutral* N_2 gives additional evidence for the value $D = 9{\cdot}5$ volts. Details will not be given here, but may be found in the references cited, together with other evidence both for and against the value $D = 9{\cdot}5$.

R. S. MULLIKEN.

University of Chicago.
Oct. 2.

The Polarisation of Compton Scattering according to Dirac's New Relativistic Dynamics.

ACCORDING to the quantum-dynamical treatment of Dirac and Gordon, the state of polarisation of light scattered by free electrons is the same as on the classical theory. This result seems to be in agreement with experiments of Kallmann and Mark (*Zs. f. Phys.*, 36, p. 120; 1926) and of Lukirsky (NATURE, p. 275, Aug. 25, 1928).

On the basis of the new relativistic quantum dynamics of Dirac, Dr. Klein and I have calculated the intensity of light scattered by free electrons at rest under the influence of a plane monochromatic radiation. The result for unpolarised incident radiation was given in a note in NATURE (Sept. 15, p. 398). Here the deviation from the Dirac-Gordon formula is not small for γ-rays at large angles of scattering, although existing experimental results seem unable to decide between the two theories. Recently I have examined on the new theory the question of polarisation of the scattered light more closely.

Experiments to determine the polarisation of the Compton scattered radiation are usually done in the following way. An incident beam of unpolarised light of intensity I_0 and frequency ν, sent along the x-axis is scattered by an electron at the origin. The scattered light again falls on another electron which lies on the y-axis at a distance r from the origin. The intensity of light, which is thus doubly scattered, in the plane parallel to the x-z plane through the second electron is examined at a distance r' from this electron. Thus, for example, if the polarisation of the scattered light is the same as on the classical theory, the intensity in the z-direction will be zero. On the new theory, however, the result is different, and we get the following expression for the intensity in the plane mentioned in a direction forming an angle θ with the z-direction:

$$I = \frac{e^8}{2m^4c^8r^2r'^2}\,\frac{I_0}{(1+\alpha)^6}\left\{\sin^2\theta + \frac{2\alpha^2+2\alpha^3+\alpha^4}{2(1+\alpha)^2}\right\},$$

where $\alpha = \frac{h\nu}{mc^2}$, e, m denoting charge and mass of the electron, c the velocity of light, and h the Planck constant. The formula differs from that of Dirac and Gordon by the second term, which is independent of θ and is of the order of magnitude α^2, as was the case with the deviations between formulæ of the two theories given in our previous note. For a given frequency, therefore, a constant amount is superposed on the intensity of the Dirac-Gordon formula for all angles. The additional term is small for ordinary X-rays, but is of about the same order of magnitude as the first term for γ-rays. Thus for $\alpha = 1$, and 2, which correspond to the wave-lengths of 2×10^{-10} cm. and 1×10^{-10} cm. respectively, the second term is about 0·6 and 2 times the first at $\theta = 90°$ respectively.

The experimental results of Kallmann and Mark cannot decide between the two theories, since the wave-length used is too long to make the difference appreciable. On the other hand, Lukirsky's results seem to be in favour of the Dirac-Gordon theory, if the wave-length used in his experiment is between 0·07 A. and 0·1 A., as was mentioned in his note. For by using the mean value of these frequencies in our formula, we find the intensity at $\theta = 0°$ to be about 6·5 per cent of that at $\theta = 90°$, instead of 2·5 per cent as was found by Lukirsky. If the wave-length used were 0·14 A., his result would be in agreement with our formula. More accurate measurements with X-rays of short wave-lengths as well as with γ-rays are desirable for the test of the present theory.

Y. NISHINA.

Universitetets Institut for teoretisk Fysik,
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Sept. 29.

Natural Pyramids on a Beach in the New Hebrides.

WHILE engaged recently in biological research in the New Hebrides (in the Pacific Ocean) under the Percy Sladen Trust, I came across a curious geological phenomenon on the black sandy beach to the east of the mouth of the R. Yoro in Big Bay, Espiritu Santo. I have never heard of anything resembling it in any part of the world. Possibly there are readers of NATURE who can explain it.

All the way along the beach for three or four miles there extends a row of piles of pebbles. Most of these piles are a couple of feet high in the middle and a dozen paces across. They are covered at high tide and wholly or nearly wholly exposed at low tide. The constituent pebbles, of black volcanic rock, are mostly oval in shape, somewhat flattened, and perhaps three or four inches long. Between each pile of pebbles and

the next there is in most cases an expanse of sand several paces across, which is almost bare of pebbles. There is a tendency for the piles to assume a definite shape (see Fig. 1), namely, the shape of a very low

FIG. 1.—Plan.

three-sided pyramid, inclined on the beach in such a way that the landward side of the pyramid is almost level (Fig. 2). In some cases a second, smaller

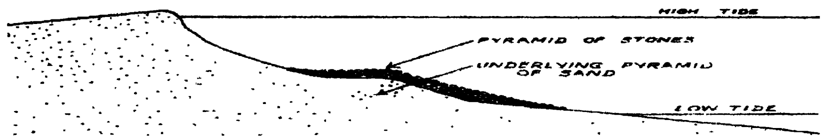

FIG. 2.—Vertical section.

pyramid has been plastered on, as it were, to the seaward side of a larger one (see right-hand side of Fig. 1). Each pile of pebbles rests on a similarly shaped accumulation of sand; and where there are no pebbles, the sand alone continues the succession of pyramids.

I erected sticks to mark the position of two adjacent well-formed pyramids, to see whether they would shift their position at all. Next day one of them was as before, while the other had shifted slightly, and a small one had arisen between them. Two days later again the two marked pyramids had *disappeared*, one completely, the other so nearly completely that I should not have guessed of its previous existence had I not marked it before.

It is perhaps significant I noticed a strong current running in a westerly direction parallel to the shore.

This curious row of low pyramids extends along the beach to the west of the mouth of the river also; but here the phenomenon is less clearly defined, for the stones are much more numerous and the pyramids are not separated by bare areas. At Tasiriki, near the south-west corner of the same island, there is a somewhat similar row of piles of pebbles.

JOHN R. BAKER.

University Museum,
Oxford.

Manuscript Herbals.

APROPOS of the article in NATURE of Oct. 27, p. 655, on "Manuscript Herbals," Dr. Singer and others interested in the subject may like to have their attention directed to the existence in the Banksian Library (MSS. No. 63), now in the Botanical Department of the British Museum (Natural History), of a volume of water-colour drawings copied from the Codex Anicia Juliana. The interesting point about this collection is that the drawings must have been made before the transference of the Codex to Vienna, since drawings imperfect or missing from the Codex are included and complete in this series.

A full description is given in the "Catalogue of Books . . . in the British Museum (Natural History)," vol. 6, p. 271.

B. B. WOODWARD.

4 Longfield Road,
Ealing, W.5.

I AM much interested in Mr. Woodward's reference to a copy of the "Juliana Anicia" Codex at the British Museum (Natural History) at South Kensington. The volume was unknown to me.

There are, however, quite a number of early copies of this magnificent Codex in existence. One such copy was described by Prof. Penzig of Genoa in 1904, in his "Contribuzione alla storia della botanica." There is another in the Cambridge University Library (Press mark Ee. 5. 7.). On this latter I was consulted some years ago by the late Prof. E. G. Browne. I convinced him of its true nature, and he catalogued it as an Oriental MS. of Dioscorides (Browne, 1385).

Another interesting copy, dating, perhaps, from about the year 1500, I found eighteen months ago in a miscellaneous volume of Greek texts at the Communal Library in Bologna. It contains figures derived unquestionably from the "Juliana Anicia," but so fantastically treated as to make them caricatures.

Yet another derivative of the "Juliana Anicia" is at the Bibliothèque Nationale at Paris (Gr. 2091). It is of the fifteenth century. I have directed attention to it in my article on ancient herbals in the *Journal of Hellenic Studies* (vol. 47).

The early history of the "Juliana Anicia" is unfortunately lost, but there is, I think, sufficient evidence that it was attracting the occasional attention of herbal illustrators throughout the ages. It is an extraordinary fact that the very elements of the art of independent plant representation should have entirely disappeared during the earlier Middle Ages, for at that period the interest in plants for herbal purposes was intense. Science was then, however, at its lowest ebb, and we have here, as I believe, an example of the penalty mankind must pay, in the end, in all its faculties, for the suppression or neglect of any one faculty.

CHARLES SINGER.

London, N.6.

Modulation of Light Waves by High Frequency Oscillations.

THE modulation of light trains by high frequency oscillations acting on a Kerr cell has been experimentally verified by Rupp (*Zeit. für Phy.*, Bd. 47) for the thallium resonance line. The results found by him seemed to agree well with the supposition that the wave form of frequency ν could be represented by an infinite wave train which would be split up into three wave trains of frequency $\nu + T$, ν, and $\nu - T$, where T is the frequency of the high frequency oscillations. However, results found by me and described below indicate that the modulations may depend on the form of the light impulse.

In these experiments, light from an iron arc was sent through a Kerr cell with plane parallel plates containing water, and the spectra of the light after passing through the cell was photographed with a quartz spectrograph. Photographs were taken both when the Kerr cell was attached to the high frequency oscillator (of approximately one metre wave-length) and when it was disconnected. In the region of the spectrum from 2385 A. to 2400 A., which was studied in detail with a densitometer, it was found that two of the lines were shifted towards the long wave-length side by 0·1 A. when the oscillator was acting on the Kerr cell, while the other eight lines which were measured in this region showed no difference in the two cases.

If we consider a light pulse of the form

$$y = Ae^{-|ax|}\cos\frac{2\pi x}{\lambda}$$

at the time $t=0$ which is propagated without change of form with the velocity of light, then we should expect, if the damping coefficient a of the pulse was simply related to the frequency of the oscillations present in the Kerr cell, that the wave train would be modified by the high frequency oscillations, causing the frequency of the light pulse with this damping coefficient to be changed.

ARTHUR BRAMLEY.

Bartol Research Foundation,
Franklin Institute, Philadelphia.

Action of Light on Coloured Bakelite.

A VERY interesting question is raised by Lord Rayleigh's letter on "Action of Light on Celluloid stained with Malachite Green," in NATURE of Oct. 27, p. 645.

Mr. A. Munro, the manufacturer of the 'Research' fountain pen, in a letter to me dated Oct. 3, 1928, discussing the colour of his pens made of bakelite, said: "The blue I gave up making . . . as in six months or less it spontaneously changed to green, and not a nice green either." Referring to another supply of bakelite, Mr. Munro said: "The colours it may change to are not yet known." In regard to a German brand of bakelite, he said: "Large quantities were sent to China a few years ago to make their images of, and it seemed an ideal substance, but now the Chinese will not have it, as the amber changed to red and blue to green, and the gods could evidently not be relied upon. A Research pen, green originally, came back from India a beautiful ruby and quite transparent."

For the information of those not acquainted with the substance, it may be mentioned that bakelite is a well-known synthetic resin made by combining carbolic acid and formaldehyde. Evidently nitro-cellulose is not the only causative agent of this curious colour change. Bakelite at first is liquid, and can be obtained as a liquid varnish, which can no doubt be stained to any desired colour. Baking at a suitable temperature polymerises it, and it becomes completely insoluble in water and nearly all other reagents.

Apparently further investigation will be necessary to determine the cause of this change of colour.

DONALD MURRAY.

Villa Waitemata,
Monte Carlo.

Low Buoyancy of Surf.

MANY reasons have been advanced for the drowning of the crew of the Rye lifeboat, but there is one which I have not seen referred to, and which, I think, must be to a great extent responsible. The first time I realised the importance of this was when standing on the rocks overhanging the rapids below Niagara. I noticed that the water was mixed to a great depth with air bubbles, and this seemed to me to throw light upon the failure of swimmers to survive the passage of these rapids.

The human body has a density approximately the same as water, and a swimmer finding himself in water containing large numbers of air bubbles is in the same position as if attempting to swim in a liquid of a much lower density than water. Suppose, for example, the water contains 10 per cent of its volume of air bubbles, the effect upon a man attempting to swim in this would be the same as if in ordinary water he tried to carry more than a stone weight upon his back.

When the sea is very rough, with a wind blowing on shore, there is usually a surf, or a number of waves breaking simultaneously as they approach the shore, and this churns up the water so that for some depth it contains a considerable amount of air in the form of bubbles. This is the cause of the white appearance of such a surf. I do not think that people fully realise the danger of attempting to swim in such aerated water; the effect is perfectly obvious when once it is pointed out, but I have not found that this danger is realised at all, and a warning as to its existence may not be out of place.

J. S. OWENS.

A Lunar Eclipse Legend.

THE legends of primitive peoples connected with astronomical events are of interest to students of the history of culture, ethnography, etc. A story of this kind explaining the eclipse of the moon was heard by me last August in Karačaj—a region to the west from Elborus (Caucasus). The Karačaïans believe that on the moon there is a handsome girl guarded by two dogs. The evil spirit Žemilaŭz, whose mouth is so large that when opened the lower lip lies on the earth and the upper on the sky (žemil = large, aŭz = mouth), wants to devour her; but he can do this only when the girl and the dogs are asleep. He watches this moment to swallow the moon with the girl and dogs. Thus begins the eclipse. The Karačaïans help the girl to be saved by means of shooting, shouting, and prayers. All this noise, they believe, must awaken the dogs, which, on their part, will wake up the girl. The girl being awakened, she is beyond the power of Žemilaŭz, who is then obliged to discharge the moon.

N. IVANOV.

Astronomical Observatory,
Moscow.

Preparation of Tantalum Pentabromide.

DURING the course of preliminary investigations which are now in progress with the view of re-determining the atomic weight of tantalum, it has been found that tantalum pentabromide can readily be prepared in an atmosphere of nitrogen or argon by distilling bromine on to powdered tantalum heated to 260° to 300°. Heating the metal to red heat, as done by Moissan (*Comptes rendus*, 134, 211; 1902) and subsequent workers, has been found unnecessary. It is hoped later to present in a paper details of the experimental procedure adopted, together with the results of analytical determinations.

K. R. KRISHNASWAMI.

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What is a Hybrid?

EVERY year, when discussing questions of genetics with my classes, I am compelled to explain that the text-book uses the word hybrid in a very loose way, including heterozygous individuals of all kinds. According to this common usage, the world is full of hybrids, and all human beings are hybrids. I suggest that it would be more convenient to restrict the name hybrid to crosses between species. Crosses between variations or mutants are mongrels, but it may be better to use a more technical or international word, and I suggest 'heterogene.'

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado,
Oct. 26.

The Ritchey-Chrétien Reflecting Telescope.

THE reflecting telescope possesses one obvious advantage over the refractor, in that the position of the focus is independent of the colour of the light used. But as an offset to this all types of reflectors which have been used by astronomers suffer from the fact that the field of good definition is comparatively small. It is true that, provided the mirrors be correctly figured, rays of light parallel to the principal axis of a Newtonian or Cassegrain reflector converge accurately to a focus, but a beam of parallel rays coming in in any other direction does not do this, and appreciable coma sets in at a comparatively small distance from the centre of the field of view.

It is in consequence of this defect that reflectors have so far not been used extensively for accurate positional work involving the precise measurement of good images, although they have been invaluable in colour photometry. As an exception to this general rule, however, it should be remarked that Dr. van Maanen has used the 60-inch reflector at Mount Wilson for the purpose of the photographic determination of stellar parallax—a research involving the most delicate and careful measures of position. Dr. van Maanen has usually chosen his comparison stars at a distance not exceeding eight minutes of arc from the centre of the field, and we have it on the authority of Prof. Ritchey that with this instrument really accurate measurements cannot be made at a distance greater than fifteen minutes from the centre.

The development of large reflectors, culminating thus far in the 100-inch mirror at Mount Wilson, has brought the astronomer up against another difficulty. The mirror is figured on a single large disc of glass, and for the largest mirrors the figure is apt to be spoilt by the flexure of the disc and by distortions introduced by temperature changes. In the case of the 100-inch the mirror had to be cast in three pourings, with the result that the bottom layer has, through de-vitrification, lost its rigidity, thereby impairing the general strength of the composite disc. In recent years Prof. G. W. Ritchey, with the co-operation of Prof. H. Chrétien, has devoted himself to the overcoming of the present defects in large mirrors and of the mechanical difficulties which threaten to bar the road to further progress. An account of these researches and of the designs to which they have led has been given by Prof. Ritchey himself in recent numbers of *L'Astronomie*, and also in a series of articles at present appearing in the *Journal of the Royal Astronomical Society of Canada*.

In 1905, Schwarzchild had shown by detailed calculation that it was possible to design a reflector which would give a large field of good definition. His plan consisted of allowing the light after reflection at the large concave mirror to impinge on a smaller concave mirror placed *inside* the focus of the large one. The beam then came to focus at a point on the optical axis *between* the two mirrors. The curves of the mirrors were not paraboloidal and ellipsoidal but departed from these forms, and Schwarzchild showed that they could be figured so as to secure good images at large angular distances from the centre of the field without at the same time spoiling the axial images. With such an arrangement, ratios of focal length to aperture as low as 2·5 to 1 could be secured. Schwarzchild probably regarded his design as giving a special type of telescope for a special purpose—a small focal ratio with a large field of view—but it could not be generally useful on account of certain defects. As designed, the diameter of the small mirror was half that of the large one, thereby cutting off a large proportion of the incident light. The photographic plate had to be situated between the two mirrors, thereby cutting off more light apart from the obvious awkwardness of such a position. Furthermore, the tube had to be inordinately long and consequently unwieldy.

Prof. Chrétien has continued the mathematical investigations thus begun by Schwarzchild, and has designed a telescope in which the usual Cassegrain form is adhered to, that is, in which the light after reflection at the large concave mirror is again reflected by a small *convex* mirror, placed inside the focus of the large one, and then passes through a hole in the centre of the large mirror and comes to a focus beyond. Following Schwarzchild's lead, the mirrors are not figured exactly to the paraboloidal and hyperboloidal forms, but are designed so as to give a wide field of good definition. One such design gives a focal ratio of 6·8 to 1, and the instrument as designed is compact and workable. The field is slightly curved, and in order to make the best use of it a spherically curved photographic plate is necessary. Alternatively, a correcting lens can be placed nearly in contact with a flat photographic plate.

Turning to the actual construction of mirrors, Prof. Ritchey has carried out careful researches in this direction. It will be remembered that he was intimately connected with the making of the 60-inch and 100-inch mirrors at Mount Wilson, and his experience of the various difficulties attending their construction and use has led him to concentrate his talent on new and improved designs. He has now designed a type of mirror in which, instead of figuring a single disc of glass, the mirror is a honeycomb structure composed of *cells* built up from thin plates of glass with their edges ground and cemented together. A thin spherical shell of plate glass is fitted on to the upper surface of the cellular structure to which it is then cemented, and a sheet of plane glass is similarly cemented to the lower surface. The upper surface is then figured to the required form.

The cellular mirrors constructed in this way are very light in comparison with other mirrors of the same aperture, and Prof. Ritchey anticipates that it will be quite practicable to construct a mirror of 10 metres aperture. Furthermore, they can be ventilated by circulating air through the cells, and in this way distortions arising from temperature inequalities can, it is claimed, be eliminated.

It must be emphasised at this point that the designs for the new telescope with a wide field of good definition, and for the new cellular type of mirror do not merely exist on paper. Prof. Ritchey has constructed in the optical laboratory of the Paris Observatory the mirrors for a model of this kind. Such instruments are to be known as Ritchey-Chrétien reflectors. In the model which has been constructed the aperture is 19·9 inches and the focal length of the combination 136 inches. The two mirrors are 41·73 inches apart, the convex being of 4·9 inches aperture. The focus is situated at a point 6·3 inches behind the vertex of the optical surface of the large mirror. The mirrors are of the cellular type described above, and are figured according to Prof. Chrétien's designs. The field is spherical and is concave towards the incident light, with a radius of 23·62 inches. Spherically-concave photographic plates have been constructed for use with the model. These are easily moulded to the required curvature. But it may be remarked here that, so far as astronomy of position is concerned, the precise measurement of images on a curved plate will present a difficulty to be overcome.

Optical tests with an artificial star have been carried out with this model, and also with a Newtonian model of the same aperture and focal length. These tests make interesting reading. Even at a distance of $2\frac{1}{2}$ minutes of arc from the centre of the field the images of the Newtonian reflector are distorted by appreciable coma. It is otherwise with the Ritchey-Chrétien model. Up to 20 minutes of arc from the centre of the field, the image is a diffraction disc of about 0·28 seconds of arc in diameter. Beyond this and up to 60 minutes from the centre they are approximately circular, the diameter of the image at 60 minutes being eight seconds of arc.

This much has been accomplished, and it is clear that the accomplishment represents something of the nature of a revolution in the design and construction of reflectors. There seems no reason why instruments of moderate size of the Ritchey-Chrétien type should not be constructed, and astronomers would welcome their obvious advantages. No doubt the constructional technique would develop in a normal manner and larger instruments would appear in the course of time.

Prof. Ritchey has, however, determined to go immediately to instruments of the largest kind, and he has already designed telescopes up to ten metres aperture. Space forbids a detailed description of his plans, but one such design provides for a fixed vertical telescope with cœlostat. The aperture is to be 10 metres and there are to be interchangeable mirrors, so that five combinations of focal ratios ranging from 2·75 to 20 will be available.

Prof. Ritchey has announced his intention of constructing such an instrument. Whilst sympathising with his desire for rapid progress, many astronomers will feel that it would perhaps be more desirable to consolidate the ground already occupied and to erect an instrument of moderate dimensions under practical working conditions in an observatory. At the same time, if Prof. Ritchey's great adventure is successful, they will be the first to rejoice with him: in the meanwhile they will wish him good luck.

W. M. H. G.

The States of Aggregation of Condensed Helium.[1]

By Prof. W. H. KEESOM, University of Leyden.

IN virtue of the very low value of its interatomic forces, helium—discovered in the solar chromosphere in 1868 and obtained from terrestrial sources by Ramsay in 1895—represents the ideal gas more nearly than any other known substance, and is the thermometric gas *par excellence*, while its extremely low critical temperature and boiling-point furnish the means of descending the scale of temperature to the immediate neighbourhood of the absolute zero.

The first experimenters to attempt the liquefaction of helium were Dewar and Olszewski. The method they used—cooling the gas in liquid hydrogen and then allowing it to expand—proved ineffectual, but success attended the efforts of Kamerlingh Onnes, who, in 1908, resorted to the procedure employed ten years earlier by Dewar for the liquefaction of hydrogen. Fig. 1 shows diagrammatically the arrangement of the apparatus. The helium from the storage cylinders was compressed into the liquefying vessel, in which it was cooled, by means first of hydrogen vapour and afterwards of liquid hydrogen boiling under reduced pressure, to $-258°$ C. The cooled helium then passed into the spiral regenerator and through the expansion valve, part undergoing liquefaction in virtue of the Joule-Kelvin phenomenon. The lower part of the liquefaction vessel has been since modified to allow of the transference of the liquid to a cryostat, in which it can be subjected to physical measurement. In a later experiment for obtaining the lowest possible temperature, Onnes made use of a battery of Langmuir mercury condensation pumps in conjunction with a preliminary series of powerful mechanical pumps. To judge whether helium at those extremely low temperatures would solidify, he introduced into the Dewar vessel containing the liquid helium a small metallic cylinder suspended from a rod and capable of being moved upwards or downwards.

The results of these experiments showed that, whereas hydrogen boils at 20° abs. and the temperature 10° is attainable by bringing the solid hydrogen under diminished pressure, a temperature little above 0·8° is brought within reach by the similar use of liquid helium, with boiling-point 4·2° abs. At this temperature, however, the helium, under its own very low saturated vapour pressure, retained its liquid state.

[1] From a lecture before the Fifth International Congress on Refrigeration, at Rome, delivered on April 13.

My experiments, which resulted in the solidification of helium, demonstrate clearly that such solidification requires not only a temperature at which the interatomic forces overcome the thermal

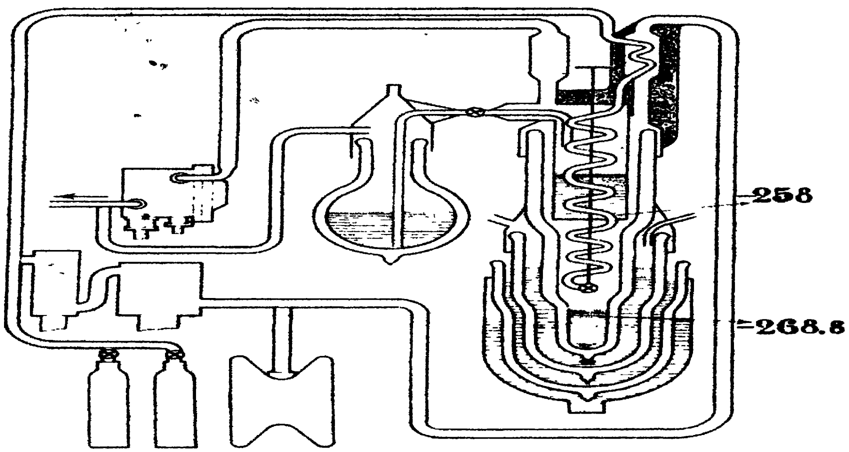

FIG. 1.

motion to such an extent that the atoms may be fixed in a crystalline lattice, but also the application of an external pressure sufficiently high to permit of free play for the interatomic forces. In the absence of such pressure the helium remains liquid at the lowest temperature yet realised, although at a certain temperature it may pass suddenly into a new liquid state of aggregation.

The apparatus used is shown diagrammatically in Fig. 2. The lower parts of two metallic tubes, B_1 and B_2, connected by a narrower tube, are immersed in liquid helium, and into these tubes helium is compressed by means of a small hydraulic pump charged with glycerine. When the plunger P of the pump is withdrawn, the mercury which half fills the two steel cylinders C, rises in the right-hand cylinder and draws helium from the supply vessel through the tap K_1 into the left-hand cylinder. The tap K_1 being then closed and K_3 opened, forward movement of the plunger P forces the helium into the system of tubes. In order to detect solidification of the helium, these tubes communicate with the branches of a differential manometer, consisting of a steel tube D passing into a steel chamber E partially filled with mercury. If a block of solid helium forms in the lower portion of the tubes and the tap K_2 is opened for an instant, a certain amount of gaseous helium escapes, and, the tap K_4 connecting the tubes being closed, the pressure in the right-hand tube becomes lower than that in the left and the mercury in the steel tube of the differential manometer rises. This tube contains a thin platinum wire forming part of one of the arms of a Wheatstone bridge; the mercury rising causes deflection of the galvanometer needle.

Another device, introduced later, and due originally to Kuenen, consists of a stirrer of soft iron H—capable of being raised and lowered magnetically—enclosed in the glass tube F communicating with the helium tubes through a metal tube; this glass tube is actually placed within the helium cryostat, although shown outside for the sake of clearness.

By adjusting the temperature of the helium bath by variation of the pressure exerted thereon, and ascertaining the corresponding pressure in the helium tubes necessary to produce blocking, the fusion curve of helium was followed for pressures ranging from 25 to about 140 atmospheres, the corresponding range of melting-point being about 1·2°–4·2° abs. At its lower end the fusion curve becomes more and more nearly parallel to the temperature axis and exhibits no tendency to meet the vapour pressure curve in a triple point, so that co-existence of gas and solid, and hence sublimation, appear impossible (below the critical temperature of helium).

Experiments made with the glass tube revealed neither change of volume nor change of state, nor a surface of demarcation between either gas and liquid or solid and liquid. Nevertheless, the solidification of helium was demonstrated in this experiment also, for a block of solid helium could be hammered. It is evident that, at the pressures used (about 90 atmospheres), the densities and the refractive indices are nearly identical for the three phases.

In the course of a series of measurements of the dielectric constant of liquid helium, carried

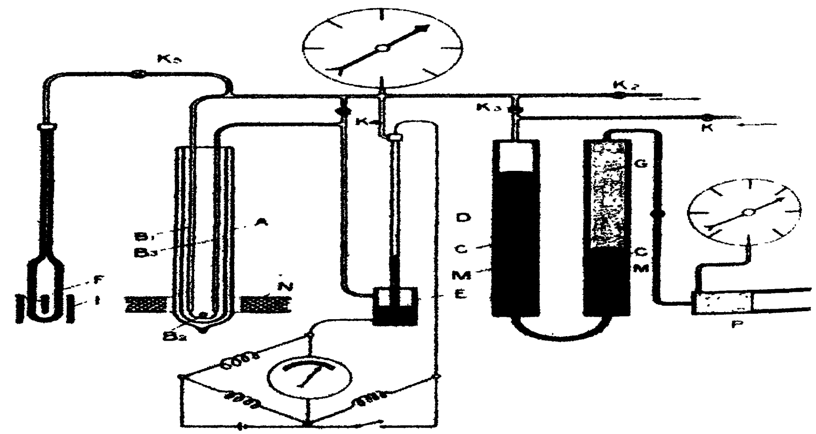

FIG. 2.

out with the collaboration of Prof. Wolfke of Warsaw, it was noticed that this constant undergoes a sudden or, at any rate, a very rapid change in magnitude at about 2·3° abs., which coincides sensibly with the temperature at which Onnes and Boks observed a maximum value for the density of the liquid. It appears that helium exists in

two liquid modifications, liquid helium I being stable above 2·3° and liquid helium II at lower temperatures; the density of the former is about 0·1 per cent higher than that of the latter.

Measurements of the specific heat of liquid helium were made by Dana and Onnes, who did not, however, publish the relatively high values obtained at temperatures near 2·3°, as these were not considered to be in accord with the other results. The apparent discordance is evidently due to the heat of transformation of helium I into helium II, which is calculated to be −0·13 cal. per gram. The heat of evaporation of helium appears to show a sudden variation, the value for helium II being the greater, while the surface tension of helium I exceeds that of helium II by about 3 per cent. It is remarkable that this transformation occurs at a temperature which corresponds, in the sense of the van der Waals' law of corresponding states, with the temperatures at which other substances melt.

Helium has, then, a triple point: liquid helium I—liquid helium II—vapour. Up to the present, such a point has been observed only for certain substances of complicated composition exhibiting a mesomorphic state (crystalline liquid), but further investigation is necessary before it can be ascertained if this is the case with helium. Fig. 3 is the characteristic diagram of the different states of helium, and shows the curve of saturated vapour pressure, the triple point, and the melting-point curve. Between liquid helium I and liquid helium

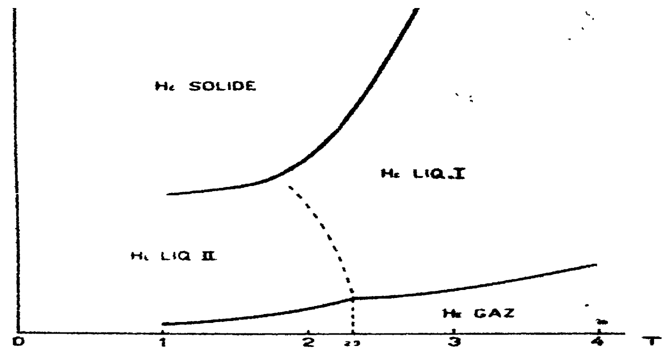

FIG. 3.

II there must be a transformation curve, but it is not yet known if this curve meets the melting-point curve, as shown in the diagram, or if it bends towards the axis of pressure.

Obituary.

PROF. G. H. BRYAN, F.R.S.

THE death of Prof. George Hartley Bryan on Oct. 13 removed one of the most interesting personalities among British mathematicians. His influence was felt in several directions, but it is in the mathematical theory of aeroplane flight that his work has made the greatest and most lasting impression.

Bryan was born at Cambridge on Mar. 1, 1864, the only child of Robert Purdie Bryan of Clare College. He lost his father at a very early age. His mother lived to a good old age, and Bryan always spoke of her with the greatest affection. He was brought up by his mother and his grandparents. He was the idol of the household, and being supposed to be delicate he was never allowed to go to school. Even when he went to Peterhouse as an undergraduate he was not given the opportunity of becoming self-reliant, for he still lived at home. The result of such an upbringing, in which discipline was totally absent, was a rather noticeable eccentricity, which did not, however, cover up a remarkable simplicity, honesty, and kindliness of character. Much of Bryan's early life was spent in Italy, France, and Germany. His excellent knowledge of the languages of these countries influenced both his scientific work and his literary style.

Bryan was fifth wrangler in the Mathematical Tripos of 1886 and second Smith's prizeman. He was a fellow of Peterhouse from 1889 until 1895. He succeeded the late Dr. G. B. Mathews as professor of pure and applied mathematics in the University College of North Wales, Bangor, in 1896, and held the chair until his retirement in 1926.

Hydrodynamical problems occupied Bryan's attention during the whole of his mathematical career. Inspired by the work of G. H. Darwin, he wrote important papers on the waves on, and the stability of, a rotating liquid spheroid, in 1888 and 1890. He soon became interested in the motion of solids through liquids, and in 1900 he produced a mathematical theory of the action of bilge keels in extinguishing the oscillations of a ship. This work was recognised by the award of the gold medal of the Institution of Naval Architects in 1901. He returned to the theory of discontinuous fluid motion as applied to a bent plate, in collaboration with Mr. R. Jones, in 1914, but meanwhile the fundamental work of Levi-Cività had introduced new methods for dealing with curved barriers, and the work of Lanchester, Joukowski, and Kutta was leading to the development of the powerful Prandtl theory. Later on Bryan wrote on the motion of an elastic fluid past a barrier.

The Cardiff meeting of the British Association in 1891 was the occasion of Bryan's important report on thermodynamics. He also wrote several independent researches based on kinetic theory, and when the "Encyklopädie der mathematischen Wissenschaften" was planned, Bryan was invited to contribute the section on thermodynamics. This appeared in 1903.

Bryan became interested in aviation very early,

long before actual flight in an aeroplane had become possible. So early as 1901 he delivered a lecture at the Royal Institution in which he affirmed his belief in the possibility of artificial flight. Two years later he realised the necessity of making an attempt to ensure the longitudinal stability of flying machines, and in January 1904 he published, in collaboration with Mr. W. S. Williams, the epoch-making paper on the longitudinal stability of aerial gliders, in which he introduced the important conception of resistance derivatives, deduced the biquadratic equation which governs stability, and applied Routh's discriminant to the obtaining of the conditions of stability.

This mathematical theory gained the approval neither of mathematicians nor of those brave pioneers who demonstrated the practicability of aeroplane flight in the first decade of the present century. But Bryan persevered in his somewhat lonely work, and seven years later he published his "Stability in Aviation," a book that may now be reckoned as a classic in aeroplane theory. Meanwhile the Advisory Committee for Aeronautics had been established, and a department of aeronautics set up at the National Physical Laboratory. Bairstow developed practical methods for finding the numerical values of the resistance derivatives by means of the aerodynamic balance and wind channel, and very soon Bryan's theory of stability became an integral part of all aeroplane design. His triumph was complete when in 1914 he was awarded the gold medal of the (now) Royal Aeronautical Society. It is difficult to over-estimate the service thus rendered to aviation by the theoretical mathematician.

Bryan continued to interest himself in the rigid dynamics of aviation, and inspired the researches of many workers. From 1917 until 1920 he worked with the advantage of a special grant, which enabled him to set himself free from teaching duties for a part of the time. He spent several months at Bristol in collaboration with the present writer and Mr. D. Williams, elaborating the theory of canonical forms for dealing with the general motion of an aeroplane.

In addition to the honours already indicated, Bryan obtained the fellowship of the Royal Society in 1895, and was elected honorary fellow of Peterhouse in 1915. He served as president of the Mathematical Association and of the Institution of Aeronautical Engineers. He was an honorary member of the Calcutta Mathematical Society. Reference must also be made to the series of text-books written by Bryan on mathematics, mechanics, and astronomy for the University Tutorial Press.

Bryan married Miss Mabel Williams in 1906. Mrs. Bryan is now living at the villa near Bordighera in Italy, where Prof. and Mrs. Bryan made their home on Bryan's retirement in 1926. Their only daughter is now a student at Cambridge. A fortnight before his death, Bryan met many friends at the International Mathematical Congress at Bologna.

In the words of an old friend of Prof. Bryan, Dr. F. J. Allen of Cambridge, Bryan was distinguished by "straightforwardness of character and generosity; by an ardent love of the beautiful in landscape, and for living things such as plants and insects which are so bound up therewith; by his great love of music, and the large part of his mind which it occupied." Bryan devoted much thought and experiment to the working of 'player' pianos, and invented an apparatus for accentuating any particular note or melodic passage. His two years of retirement at Bordighera were made happy by friendly intercourse with the Italian peasants, whose language he spoke so well, and 'Il Professore' was known and loved in many a mountain village far off the beaten track of the ordinary tourist.

S. BRODETSKY.

SIR ALEXANDER KENNEDY, F.R.S.

A NOTABLE figure in the engineering and scientific world is removed by the death of Sir Alexander B. W. Kennedy, F.R.S., in his eighty-second year. Born in London in 1847, the son of the Rev. John Kennedy, D.D., and Helen Stodart, sister of Prof. John Stuart Blackie, Kennedy received his early education at the City of London School and the School of Mines, Jermyn Street. In those early days there were no means of further education in his chosen profession of engineering, except by its actual practice, and for the next few years Kennedy was laying the foundations of his ultimate eminence as an engineer in the workshops and drawing offices of well-known firms of marine engineers in London and the north. In a surprisingly short time he was a leading draughtsman and an authority on the design and construction of the machinery of ships, and evincing thus early the keen judgment and sagacity in practical affairs which were so marked a feature of his character.

At the early age of twenty-seven, a turning-point in Kennedy's career was reached when he applied for, and obtained, the professorship of engineering at University College, London. It was a momentous step for the electors and himself, which was amply justified by events, for Kennedy proved to be an ideal professor as well as a notable pioneer in education and applied science. His outstanding educational achievement was his invention of the engineering laboratory as an essential part of a university course, a system which has spread all over the world and has proved so potent an influence for good in engineering education.

In his scientific work Kennedy was much attracted by the kinematic analysis of Realeaux, which he brought into prominence here by his lectures and his well-known text-book on "The Mechanics of Machinery." On the experimental side he became an authority in many branches of applied science, such as the scientific testing of boilers and steam engines, and also by researches on the properties of engineering materials and structures, for which he designed an autographic stress-strain recorder of great sensitiveness. As time went on, his advice and assistance on engineering matters were so much sought after that the strain became too great and he resigned his professorship in 1889 and went into practice as a

consulting engineer, although he remained in intimate touch with University College to the end of his life, and his name is permanently associated with his old chair there.

It may seem somewhat surprising that Kennedy's activities soon took a new turn into electrical engineering, for which there seemed to be no warrant from his previous training and experience, but possibly this can be explained by the fact that this branch was in its infancy and that what it then needed more than anything else was the mechanical engineering ability which Kennedy possessed in so remarkable a degree, for the major difficulties of that period were not so much electrical as mechanical.

It would take too long to enumerate the great electrical engineering enterprises with which Kennedy was associated: railways, tramways, power houses, and the like. There was one common feature in all this work, that Kennedy's advice was always of the best and his undertakings successful. Naturally, his share of honours was great. He became a fellow of the Royal Society in 1887, president of the Institution of Mechanical Engineers in 1894, and president of the Institution of Civil Engineers in 1906, a year after receiving the honour of knighthood for eminent services in naval matters connected with boilers and machinery. He was also the recipient of many honorary degrees and distinctions.

All this, however, does not really give an adequate idea of Kennedy's many-sided character, for he possessed by heredity and training that love of knowledge, culture, and adventure which led him into many fields: music, archæology, photography, and mountain climbing were some of his recreations, and he excelled in a knowledge of them all. He will be much missed by a large circle of friends, among whom will be numbered all his old students, who derived so much inspiration from his teaching and example.

DR. THEODOR PAUL.

WE are indebted to the *Chemiker-Zeitung* for the following details of the life of Prof. Theodor Paul, of Munich, one of the best known authorities on pharmaceutical chemistry, who died on Sept. 30, after a long illness.

Born in 1862 at Lorenzkirch on the Elbe, Paul took up the study of pharmacy on leaving school, and after some years' experience as an assistant he entered the University of Leipzig. After obtaining a qualification in pharmacy he took up the study of chemistry under Prof. E. Beckmann, and graduated in 1891. After graduation Paul came under the influence of Prof. Wilhelm Ostwald, who aroused in him a keen interest in physical chemistry, the effects of which were noticeable in all his later work. After serving as assistant to Ostwald for six years he was appointed assistant to Beckmann in the newly established laboratory of applied chemistry, and in 1898 he followed Buchner as extra-ordinary professor of analytical and pharmaceutical chemistry at the University of Tübingen. Meanwhile he had commenced the study of medicine, and while still at Tübingen he graduated a second time at Leipzig, this time in the faculty of medicine. In 1902 he was appointed director of the research department of the Imperial Public Health Office in Berlin, where he remained until 1905, when he followed Hilger as professor of pharmaceutical and applied chemistry at the University of Munich.

Paul took a prominent part in the preparation of the fifth and sixth editions of the "Deutsches Arzneibuch," and he published numerous papers on the investigation of food and drugs. In 1921 he accepted an invitation to deliver a course of lectures at the University of Madrid. He filled many important offices, and at the time of his death was director of the German research institute for the chemistry of foodstuffs and a member of the Bavarian Academy of Science.

MR. WALTER BROCKETT, head assistant in the Zoological Laboratory, Cambridge, died on Nov. 11. He had been in the same employment for forty-eight years, at first as a boy under F. M. Balfour and later under Adam Sedgwick and the present writer. He was an expert at section cutting, at first single sections and then as an operator of the original ribbon machines, which by his criticisms he helped to perfect. A part of his business was to mark off students at lectures and practicals, and a rough calculation shows that more than 7000 names are recorded in his books; he seldom forgot the name of anyone therein, and he generally would recall their peculiarities and athletic distinctions. A photograph of the annual laboratory cricket match, 'Assistants *v.* Staff,' shows him as captain seated alongside Dr. Gaskell, who had Sir Michael Foster, Sir Francis Darwin, Dr. W. Bateson, Sir Morley Fletcher, Prof. Barclay Smith, Mr. Brindley, Mr. Warburton, and the writer in his team. He regarded Cambridge as *his* University, the Laboratory as *his* department, and its graduates as *his* students, and he was proud of them. He was noted in Cambridge for his successful management and training of laboratory assistants, most of whom migrated to other universities. His affectionate and loyal relations with professor and staff makes their sense of loss very deep and personal. He leaves a fine example of whole-hearted loyalty and devotion. J. S. G.

WE regret to announce the following deaths:

Dr. John A. Bownocker, chairman of the department of geology at the Ohio State University since 1916 and State geologist of Ohio since 1906, who was interested chiefly in the economic geology of the region, on Oct. 20, aged sixty-three years.

Sir Hector Cameron, C.B.E., emeritus professor of clinical surgery in the University of Glasgow, a pupil and assistant of Lister, on Nov. 25, aged eighty-five years.

Dr. E. A. Schwarz, of the Bureau of Entomology of the U.S. Department of Agriculture, who was distinguished particularly for his knowledge of the Coleoptera, on Oct. 15, aged eighty-four years.

News and Views.

RESEARCH work in matters pertaining to forestry science has received a great impetus as a result of the War. In the case of forestry in the British Empire, the reasons are more apparent perhaps than in that of Europe. The countries overseas had, during the great struggle, to be self-supporting in several directions where the raw products of the industries concerned came from the forest. The armies in the East and Middle-East were dependent upon the semi-tropical and tropical forests for the supplies required to carry on their operations. Timbers of many kinds were made use of which had not previously found a place upon the markets; and not timbers alone, for other forest produce became marketable on the grand scale, which had only previously been tapped in a tentative manner. That the importance of research work in forestry in the tropical and semi-tropical forest regions came to receive recognition is not therefore surprising. In Europe the need of research work was not so widely accepted before the War. Although scientific forest management had been practised for a long period in several of the European States, yet it was not before 1891 that some effective recognition of the importance of research work was given by the founding, at a meeting held at Badenweiler, of an international union or association termed the 'International Union of Forest Research Stations.'

As its name implies, the object of the International Union of Forest Research Stations was to have periodical meetings between those engaged in forestry research, with the object of exchanging ideas and, so far as possible, introducing standard methods between the countries for carrying out certain classes of investigation work. The last meeting of the Union so founded, which was the sixth, took place in 1910 in Brussels. The succeeding meeting was fixed for 1914, to take place in Hungary. The War intervened, and no meeting has since been held. As an outcome of the War and the rising demands for timber in Europe, several of the States have realised that, by intensive management, a larger return should be obtainable from the forest areas, and that to obtain such returns demands careful investigation and research work. A revival of the research union came under consideration. During the International Forestry Congress at Rome, held in May 1926, the matter was discussed between a number of the delegates who had the cause of research work at heart. It then transpired that a small meeting of a few Continental experts had been held at Zurich shortly before, with the idea of resuscitating the International Union; and that the Swedish representative had been elected president and commissioned to endeavour to summon a congress in Stockholm in 1928 or 1929. At Rome the project matured, and an invitation to attend a congress, to be held at Stockholm in July 1929, has now been issued by Prof. Henrick Hesselman, chief of the Swedish Institute of Experimental Forestry.

A LARGE *Ichthyosaurus*, at least 30 ft. long, has been discovered at the works of Greaves, Bull, and Lakin at Harbury, near Leamington, Warwickshire. The specimen is interesting for its large size and good preservation. All the paddles are present, and the skull appears to be complete, though the individual bones are somewhat displaced. Most Lias ichthyosaurs lie crushed on limestone surfaces; but these remains lie in hardened shale, and it should be possible so to develop them that the skeleton can be mounted 'solid,' like the reptiles from the Oxford Clay. The species is almost certainly *I. platyodon* Conybeare. The specimen was found at a higher horizon of the Lias than the plesiosaur which occurred in the same quarry in the *angulatus*-beds and was acquired by the British Museum a year ago. It is hoped that associated ammonites will enable the exact age of the present specimen to be fixed. Messrs. Greaves, Bull, and Lakin have most generously placed the specimen at the disposal of the Trustees of the British Museum, and it should prove a valuable addition to the remarkable series of ichthyosaurs already in the collection.

THE name and personality of Sir Paul Rycaut, F.R.S., traveller, author, and diplomatist, born in the autumn of 1628—three hundred years ago—at the Friary, Aylesford, Kent, is worthy of remembrance. Rycaut's connexion with the Royal Society began on Dec. 5, 1666, when at a meeting he was proposed a candidate by Henry Howard, afterwards sixth duke of Norfolk, who, by the way, had been himself elected in the previous month. "It being intimated (we read) that the said Mr. Rycaut was to go into Turky, and offered his services to the society in inquiring into philosophical matters, it was ordered that the secretaries should get ready, both a copy of the general inquiries for all countries, and of such particular ones as were proper for Turky; which last were recommended to the consideration of Mr. Hoskyns and Mr. Oldenburg." Rycaut was elected at the ensuing weekly meeting, and admitted as well.

HOWARD's interest in Rycaut is further exemplified by the following minute: "There were produced by Mr. Howard's servants several pictures of Turkish habits (to the number of sixteen single and eight double ones) as well as those of the grand signor and the empress, as of those of their officers and servants. He desired that they might be put into the library of Arundel House." Rycaut as an envoy from England was a marked success; also, he became a skilled narrator. His chief work (amongst many) was "The Present State of the Ottoman Empire . . . illustrated with divers pieces of sculpture, representing the variety of habits among the Turks." London, 1668. Rycaut returned to England for good in 1679; six years afterwards he again took office as secretary to the Earl of Clarendon, and was knighted. To the *Philosophical Transactions* he communicated a paper in April 1699, entitled, "A Relation of the small creatures called Sable-Mice." . . . A fine portrait of Rycaut, by Lely, may be seen in the National Portrait Gallery. It was engraved by R. White, and forms a

frontispiece to the "Turkish History." Rycaut was buried near his father and mother in the south chancel of Aylesford Church.

THE condition of the Bear River Marshes, Utah, has in recent years caused much concern to sportsmen as well as naturalists. Owing to scanty rainfall and to the diversion of water for irrigation purposes from Bear River and tributary streams, the shallow waters in many parts of the marshes become concentrated solutions of alkali during the summer and autumn of each year. The marshes are a gathering place for millions of wild duck and geese during the spring and autumn migrations, and it has been estimated that in the course of the past few years not fewer than 7,000,000 ducks alone have died owing to alkali poisoning. So serious had the problem become that the Federal Government took the matter in hand, and after sundry delays in Congress during the past two years a Bear River Migratory Bird Refuge Bill has at length been signed by President Coolidge. It grants authorisation for expenditure of 350,000 dollars to be used by the Secretary of Agriculture in the construction of such dykes, ditches, spillways, sluices, etc., as may be necessary for establishing a suitable refuge and feeding- and breeding-ground for migratory wild fowl. This is a most important step in wild-bird conservation, which will result in economic as well as æsthetic advantages, for it is predicted, we learn from *California Fish and Game*, that the food value of the birds that can be saved in a single season will exceed the cost of the proposed improvements.

AT a conference of the Superintendents of the National Parks of the United States of America, held on Feb. 17, 1928, Dr. Joseph Grinnell read a paper upon the balance of life in national parks, which bears on the question of the proper maintenance of animal preserves in any country. He discusses the troublesome problem of the artificial regulation of the balance of life so that no dominant animal may attain too great a share of the preserve at the expense of any other, and in particular that of beasts of prey which live upon the other inhabitants of the reserve. In this matter his conclusion is that "animal life in the national parks should simply be let alone. It can be encouraged in amount and variety most practically by desisting from any avoidable interference with the full range of natural conditions of food and shelter. Here is a case where a *do-nothing* policy is the soundest policy." It seems doubtful if such a negative policy, however well suited it may be for the enormous ranges of the parks of the United States, is suited for the limited areas available for preserves in Great Britain. The relatively tiny Nature reserves in Britain are surrounded by cultivated land from which the surplus of dominant species tends to overflow into the reserve to the detriment of the rarer species which require encouragement. We doubt also whether the wardens of the great preserves in Africa would feel justified in adopting the *laissez-faire* policy, in view of the tendency of certain species, particularly of the larger mammals, to multiply unduly in the absence of a sufficient check from natural enemies.

WITH another of Dr. Grinnell's conclusions every naturalist will be in agreement. "First and foremost," he says, "any and all *non*-native animals must rigidly be denied admission. . . . No addition in the way of bird or mammal, reptile or amphibian, should be made to the complement of animal life in a National Park, to that which belongs there. . . . Such introductions should be guarded against like the plague." We commend these wise words to the notice of the authorities and the game warden of Kenya, which is threatened with the setting free, on a deliberate policy, of Scottish red deer and Indian black buck. Dr. Grinnell is opposed to the creation of any sort of zoo in a National Park, for where an animal may be seen in freedom no one would choose to see it in the unnatural conditions of captivity; but he thinks that a museum may serve a useful purpose if it is "conducted subserviently to the function of nature guiding," so that it directs visitors to the living animals out-of-doors, and helps them to understand and appreciate what they see in the wilds.

A COMMITTEE appointed by the Radio Manufacturers' Association of the United States recommends that all radiovision pictures at present being broadcast be standardised, so that one radiovision receiver with one scanning disc will be able to receive any of them. The committee adopts as standard the system used by C. F. Jenkins in Washington. The method recommended uses 48 lines with 15 separate pictures (frames) every second. The pictures therefore will not show much detail, being decidedly inferior in this respect to the pictures which J. L. Baird can broadcast from his laboratory. It is expected that all the television broadcast stations in the United States will adopt this standard, so that one receiver with one scanning disc will be able to receive any of them.

THE progress of electric railway work in Great Britain since the War has been disappointingly slow. On the Continent and in America, progress has been much more rapid. We learn, for example, that the Pennsylvanian Railway Company has decided to spend twenty million pounds in electrifying its entire train service between New York and Wilmington, Delaware. The 'wait and see' policy adopted by several railway companies in Britain since the late Sir Alexander Kennedy's Committee issued its report in 1921 has done very little to advance matters. We therefore welcome the report of Sir John Pringle's Committee which has just been published (London: H.M.S.O.) Most of its members have a thorough knowledge of the practical problems which now face the railway companies, and during the past few years many of them have seen how these problems have been attacked overseas. It is now suggested that the direct current system should be standardised, the pressures chosen being 750 and 1500 volts respectively.

IT appears that in March 1928 there were in Great Britain 1257 miles of track operated on the direct current (d.c.) low tension system and 77 on the d.c. high tension system. There were only 151 miles operated on the alternating current (a.c.) system and

this number is diminishing. On the higher voltage d.c. system it is suggested that the current be collected from overhead wires with an uninsulated return. On the lower voltage d.c. system the current will be collected by a shoe pressing on the third rail. To permit of interrunning between the various railway systems it can easily be arranged that every train can run on either the high voltage or low voltage network. The recommendations of the earlier commission about standardising the track are endorsed. We hope that rapid progress will now be made. Past experience has shown that the prevention of the railway currents from interfering with the Post Office work either by electromagnetic or electrostatic induction is not a difficult problem.

THE seventh annual report of the British Cast Iron Research Association, covering 1927–28, records developments in the work of the Association, especially in the direction of making its results more readily available to its members. Melting plant has been set up, and experiments on a working scale are also being undertaken in foundries belonging to members. This is a good sign, as indicating willingness to co-operate in research. Cast iron containing nickel and copper has been found to have properties which make it useful in situations exposed to corrosion, but no iron which is resistant under all conditions has yet been discovered. Special attention has been given to the effects of varying composition in the manufacture of malleable castings, and similar studies have been made with reference to iron for light castings. In the main, the work of the Association has dealt with foundry problems, and it is to be hoped that in future increased support from the industry will make it possible to undertake more fundamental research. During the past year the most important work in this direction has been that of Dr. Norbury on the influence of manganese, which reconciles some of the conflicting opinions held on this subject, and constitutes a distinct addition to knowledge.

DURING the past ten years considerable progress has been made in developing the use of X-rays. Not only has their use been extended in medical and surgical practice, but there has been a notable development in their application to the examination of problems which arise in scientific and industrial work. The present range of X-ray equipment extends from the diminutive dental outfit to the apparatus required for the examination of various materials and the inspection of finished articles. The most recent achievement was the penetration of steel to a depth of $4\frac{1}{2}$ inches by radiations from the powerful set in the radiological research department at Woolwich. In a paper read to the Institution of Electrical Engineers by L. G. H. Larsfield, on Nov. 22, the question of the standardisation of the electrical equipment of X-ray apparatus was discussed. The subjects included were induction coils, voltage transformers, filament heating transformers, rectification and switchgear, and control fittings. The Coolidge tube has now largely displaced the gas tube for X-ray work. In the former a hot cathode governs the tube current by supplying a steady stream of electrons, the impact of which upon the anode causes X-rays to be generated. Induction coils are now seldom used, having been displaced by transformers. In the author's opinion, however, for the highest voltage work there will in the future be a reversion to some improved type of induction coil. Of special interest was the description of a very small set (10 in. × 7 in. × 6 in.), weighing only 26 lb., patented by Coolidge. The tube is only 4 in. long, and operates at 56,000 volts and 10 microamperes. As the whole of the high voltage system is enclosed in an earthed metal case, there is no danger of electric shock and no external electric field. Objects under examination also can be brought very near to the tube. Other equipments were also described which are used for army requirements, such as examining the materials used in aeroplane construction, etc.

DR. E. D. ADRIAN delivered two lectures on "The Mechanism of the Nerves" at the Royal Institution on Nov. 22 and 29. The messages which are sent from the sense organs to the brain and from the brain to the muscles, are composed of a series of brief impulses—waves of chemical change which spread rapidly down the nerve fibre, leaving in their wake a refractory state from which the fibre must recover before a second impulse can pass. Impulses of the same general type may be produced in non-living systems, and the iron wire model of R. S. Lillie copies the behaviour of a nerve fibre with surprising accuracy. The impulse is accompanied by a change of electric potential, and the recent development of the valve amplifier has made it possible to record these changes with much greater certainty. Whenever a sense organ is stimulated, *e.g.* by touching the skin, it is found that a series of impulses pass up the sensory nerve fibres at a frequency which varies from 5 to 150 a second, and depends upon the strength of the stimulus. This message is somehow translated into consciousness, giving a sensation which rises or falls in intensity according to the frequency of the incoming impulses. In the same way, when a movement is to be carried out, the motor nerve fibres transmit a series of impulses to the muscles, and here, too, the frequency is varied over the same range to produce contractions of different intensity. A further means of gradation is provided by changes in the number of fibres in action. Communication between the different groups of nerve cells within the brain is probably carried out by impulse messages of the same kind, though disturbances which arise and subside more slowly must occur in certain regions. The complex reactions of the nervous system depend in the main on these more lasting changes.

IN his recent presidential address to the Surveyors' Institution, Mr. C. B. Fisher dealt with a number of points of agricultural interest. Since 1920, upwards of fifty Acts have been passed in the House of Commons which affect the land in some way or other: in consequence, the agriculturist is often uncertain as to his actual position. Changes are proceeding so rapidly that there is a danger of old records being lost; many of them cease to have present application

but their historical value is considerable. Mr. Fisher appealed particularly for the preservation of documents describing the enclosure of open fields, the growth and break up of large estates, fluctuations in size of farms and rents; these should be handed over to the custody of public libraries or local historical societies. He discussed also the disparity in price paid by the consumer to the middleman, and by the middleman to the farmer, and pointed out that the United Dairies' last balance sheet showed profits of more than £500,000, while "any addition to price to assist in meeting the cost of production is grudgingly given and passed on to the consumer." It is notorious that the payment to the farmer is so low that he can barely make both ends meet, even with the minimum agricultural wage of 30s. to 31*s*. per week.

RECENT acquisitions in the Department of Zoology of the British Museum (Natural History) include a mounted specimen of a baby sloth-bear, or Aswal (*Melursus ursinus*), from Oudh, India, presented by the Rowland Ward Trustees. This specimen measures little more than 18 inches in total length, whereas the adult bear will measure from 5 to 6 feet in length; the animal is restricted in its distribution to India and Ceylon. Rear-Admiral H. Lynes has presented a collection of birds and eggs from Africa, including 964 examples of different kinds of small fan-tailed warblers of the genus *Cisticola*. These small birds have a very intricate summer and winter plumage, which it was impossible to work out without this additional material. A specimen of the king cheetah (*Acinonyx rex*) has been acquired. Unlike the common cheetah, the markings on the skin are not in the form of spots so much as longitudinal stripes and blotches, giving the animal a very handsome and gaudy appearance. The king cheetah is found in Southern Rhodesia, and it is surprising that such men as Selous, who hunted this district for many years, never obtained a specimen or made any record of its existence. Interesting acquisitions reported by the Department of Geology include a specimen, 3½ feet long, of a fossil angel- or monk-fish (*Squatina*) from the Upper Jurassic lithographic stone of Bavaria. This fossil scarcely differs from the recent form found living in temperate and tropical coastal waters, and is intermediate between the sharks and the skates. Additions to the Mineral Collection include further examples of fluorescent minerals from the zinc mines at Franklin Furnace, New Jersey, and the Trustees have agreed to the purchase for the Department of Botany of a valuable series of 870 plants collected in Mexico by Ynes Mexia of the University of California, and a further instalment of 1237 specimens from Frère Sennen's collections of Spanish plants.

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include five assistant conservators of forests: Mr. R. G. McK. Willan and Mr. R. D. Catterall to Nigeria, Mr. E. W. March to Ceylon, Mr. C. Swabey to Trinidad, and Mr. C. Cairns to the Federated Malay States. There have been three appointments of veterinary officers, Mr. F. W. Aston and Mr. D. F. Macpherson to Kenya, and Mr. H. M. Salusbury to Tanganyika Territory. Mr. G. F. Clay, who has for some time been geneticist at the Amani Institute, has been appointed senior agricultural officer, Uganda. Messrs. D. Thornton, F. E. Buckley, and K. D. R. Davis have been appointed superintendents to the Agricultural Department, Nigeria. Mr. T. H. Nicol has been appointed agricultural instructor at Sultan Idris College, Federated Malay States; Mr. H. A. Pieris, divisional agricultural officer, Ceylon; Mr. J. L. Greig, assistant agriculturist, Federated Malay States; and Mr. E. J. H. Corner, assistant director of Gardens, Straits Settlements. Messrs. Buckley, Nicol, Greig, and Pieris were holders of Colonial agricultural scholarships.

AT the annual meeting of the American Optical Society, held on Nov. 1–3, the first award was made of the Frederic Ives Medal, to Mr. Frederic Eugene Ives, a pioneer in the invention of the half-tone process used for the reproduction of photographs, etc., for book and newspaper illustrations. The medal, which was founded recently by Dr. H. E. Ives, son of Mr. F. E. Ives, will be awarded biennially "for distinguished work in optics."

THE International Society of Experimental Phonetics has acquired *Vox* (Prof. Calzia, Hamburg) as its monthly organ of publication. Copies are sent free of charge to the members. The Society will also publish a yearly volume entitled *Psychologische Beiträge* (herausgegeben von Prof. Dr. E. W. Scripture, Wien).

"THE Royal Natural History," which was edited by Richard Lydekker, is probably the most comprehensive of popular systematic works on the animals of the world in the English language. A re-issue of this standard work, which contains 63 coloured plates, more than 2000 engravings, and nearly 3500 pages, is being published by Messrs. Warne in 18 fortnightly parts, at a price of 2*s*. 6*d*. each. Since it was first completed in 1896 this has been a standard work of reference, and its accuracy, its detailed descriptions, and the particular attention which it pays to the habits of animals, must assure it a place on the shelves of every well-equipped naturalist.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer and demonstrator in mechanical engineering in the department of mechanical engineering of the University of Sheffield.—The Registrar, The University, Sheffield (Dec. 7). A demonstrator in physics in the University of Leeds—The Registrar, The University, Leeds (Dec. 10). Two assistant lecturers in chemistry at the Battersea Polytechnic, one to conduct classes in analysis of foods and drugs and the microscopical examination of food and drugs—The Principal, Battersea Polytechnic, S.W.11 (Dec. 10). A senior demonstrator in anatomy in the University of Sheffield—The Registrar, The University, Sheffield (Dec. 11). A chemist at the Royal Naval Cordite Factory,

Holton Heath—The Secretary to the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 15). A technical assistant at a naval establishment at Portsmouth, with a sound knowledge of high frequency electrical testing methods—The Secretary to the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 15). A pathologist in the General Infirmary, Salisbury—The House Governor and Secretary, General Infirmary, Salisbury (Dec. 17). A professor of mathematics in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, W.C.2 (Dec. 18). A public analyst for the County of Cornwall—The Clerk of the County Council, County Hall, Truro (Dec. 22). A professor of mechanical engineering at the College of Engineering, Guindy, Madras—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (Dec. 31). A lecturer in geography in the Huguenot University College, University of South Africa—The Registrar, Huguenot University College, Wellington, Cape Province (Jan. 1). An officer-in-charge of the Wood Preservation Section of the Forest Research Station, Dehra Dun, India—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 19). A director of the Tea Research Institute of Ceylon—The Director, Royal Botanic Gardens, Kew (Jan. 30). A principal of the Technological Institute, Cawnpor The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Jan. 31). The John Lucas Walker Studentship in the pathological laboratory of the University of Cambridge—Prof. H. R. Dean, Cambridge (Feb. 19). An assistant science master with good qualifications in physics, at King Edward's School, Birmingham—The Headmaster, King Edward's School, Birmingham. An assistant in physiology in the Medical School of Dalhousie University, Halifax, Nova Scotia—Prof. A. V. Hill, University College, Gower Street, W.C.1. Junior technical officers at the Royal Aircraft Establishment for, respectively, tests and experimental work on strength of materials and aircraft components, and work in the engine experimental department—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A temporary science mistress at the Central Foundation Girls' School, Spital Square—The Head Mistress, Central Foundation Girls' School, Spital Square, E.1. An assistant master in the physics department of the Leeds Central High School—The Director of Education, Education Department, Calverley Street, Leeds. Teachers of woodwork and metalwork under the West Riding Education Committee—The Education Department (Elementary Branch), County Hall, Wakefield.

Our Astronomical Column.

New Comet.—The third cometary discovery of the year was made on Nov. 19 by Mr. Forbes, an amateur astronomer of Cape Town. It was a fairly easy telescopic object, being then estimated as of the sixth magnitude, but no tail was seen. The following observations, of which the first was noted as being only approximate, have been distributed by the I.A.U. Bureau at Copenhagen :

U.T.	R.A. 1928·0.	S.Decl. 1928·0.	Observatory.
Nov. 21·08333	12^h 8^m 30^s	21° 42′ 0″	Johannesburg.
24·21465	12 17 2·6	23 58 53	Algiers.
24·57167	12 17 59·7	24 13 32	Lick.

The estimated magnitudes at Algiers and Lick were 10 and 7. The discordance illustrates the large personality that exists in these determinations. The Lick observer was Mr. Berman.

These observations are not well spaced for orbit determination, the second and third being only 8 hours apart. An attempt (not yet completed) indicates that the motion is direct and that the distance from the earth at the middle observation was about one unit; perihelion appears to be already past, the distances from both earth and sun increasing. When this note appears, the comet will be inconveniently low in England, but may possibly be seen just before dawn in the south-east.

The Leonid Meteors of 1928.—The display this year, writes Mr. W. F. Denning, appears to have given evidence of increased activity and to have furnished some brilliant objects, if the shower was not strikingly abundant. On the morning of Nov. 16, from 2 to 3 A.M., Mr. A. King, of Ashby, Lincolnshire, found the horary rate of appearance for Leonids was 30, and he noticed several as brilliant as Jupiter. On the following morning there was a decline in activity, but at 2^h 47^m A.M. he observed a brilliant Leonid fire-ball falling from Ursa Major through Hercules. There was an explosion at the end of its flight, and the sky was illuminated in the region where it occurred, for the object was several times brighter than Venus.

From Blackheath, London, S.E., on the night following Nov. 15, several brilliant meteors with long paths and luminous trails were casually observed. One appeared at about 11^h 30^m P.M., ascending some 50° in the eastern sky from the 'Sickle of Leo,' and other large and conspicuous meteors were remarked near midnight. It is evident from the descriptions of their flights that they were Leonids. It is probable that this system of meteors will exhibit more abundance in the next few years, as the ensuing maximum and the return of its parent comet (Tempel, 1866 I) are due in 1933.

Determinations of Radial Velocities at the Cape.—*Annals of the Cape Observatory*, vol. 10, part 8, contains radial velocity determinations not previously given in the Cape publications. The first section contains a new determination of the constant of aberration and the solar parallax from the radial velocities of stars. Using Hayford's value, 6378·388 km., for the earth's equatorial radius, and Michelson's 1926 value of the velocity of light, 299800 km./sec., then the solar parallax is given as 8·803″ and the constant of aberration 20·475″. The probable errors are 0·004″ and 0·010″ respectively. It is satisfactory to note how narrow the range of different determinations of the solar parallax has become; it scarcely exceeds one-hundredth of a second.

The orbits of 13 spectroscopic binaries are determined, and the radial velocities of 434 stars. There are several different values found for the solar motion. When the K-term is taken as zero, the apex is found to be R.A. 263·6°, N. Decl. 28·8°, velocity 20·5 km./sec. An erratum on p. 11 may be noted; the period of Sirius should be 50, not 40 years.

Research Items.

THE CARRYING OF YOUNG BY MAMMALS.—In discussing the life history of the woodland deer mouse (*Peromyscus leucopus noveboracensis*) E. Raymond Hall makes a side observation of interest (*Jour. Mammalogy*, August). In a hunting cabin in Kansas he disturbed a female mouse with four young, which in her haste to seek shelter she scattered upon the floor. Within thirty seconds the mother reappeared and picked up with her teeth one of the young, and so on until she had carried all to safe places. In each case she deliberately turned the young belly up, grasped it on the under side with her incisors, and, adjusting it slightly with her fore feet, scampered away. Recalling that squirrels and some other rodents are known to carry their young belly up, rather than by the back of the neck, as cats and dogs do theirs, the author suggests that it may be a universal, or at least general, habit of rodents to carry their young belly up, and of carnivores to carry their young back up. The point is a curious one, and the experience of readers of NATURE might help to solve the question.

THE FAUNA OF HOT SPRINGS.—In the course of an investigation extending over several years, Charles T. Brues has examined the faunas of hot springs in the Yellowstone National Park, and in 1927 visited 34 hot springs or groups of springs in New Mexico, Nevada, California, and Utah (*Proc. Amer. Acad. Arts and Sci.*, vol. 63; 1928). His paper, containing careful records of the temperature, specific gravity, and *p*H of the waters, with a detailed list of the organisms found living in them, and references to other work of a similar kind, is a valuable contribution to knowledge. Of vertebrate animals he found only a cyprinoid fish (*Notropis lutrensis*) at 39·5° C., and a frog (*Hyla regilla*) at 35·8° C. Molluscs were occasionally found, but the vast majority of the population was composed of insects, of which aquatic coleoptera formed by far the most numerous section. The author discusses the nature of heat susceptibility, body temperature, the brackish water fauna in relation to that of thermal waters, and the temperature range of individual species. Unfortunately, none of the springs was suitable for following the changes in the composition of the thermal fauna over a considerable range of temperature in water from a single source, but the interesting discoveries of Blanchard and Seurat at the springs of Meskhoutine in northern Africa are quoted to illustrate the temperature stages at which fresh creatures invade the fauna.

VARIATION AND ITS ASSOCIATION WITH HABIT.—The American Fox-sparrow (*Passer iliaca*), though a bird of restricted habitat, has apparently developed a sensitiveness to environmental influences, for although in any one locality variation is slight, geographical variation is common, so that the species is split into sixteen races. A very thorough study of the variations which occur in these races has been made by Jean M. Linsdale (*Univ. California Pub. Zoo.*, vol. 30, p. 251; 1928). It is impossible to follow her into her analysis of the details of 465 specimens, but, in general, she found that significant geographic variation occurs in every part of the skeleton that was examined. Evidence was not forthcoming to show that the variations in every case were of any biological advantage. For example, races in which enlarged bills and skulls occurred were not found to use food different from their smaller-headed neighbours. One character, however, length of sternum, appeared to have a real functional value. The subspecies *iliaca* has the longest sternum in the species, and this is the race which in general breeds farthest north and migrates farthest south. Indeed, it may be said that the amount by which this race is set off from the others in respect of its sternum is roughly paralleled by the distance by which its migration route exceeds theirs. With this length of sternum goes, but to lesser extent, similar elongation of the limb bones associated with the sternum. In the other races similar behaviour of these characters can be correlated with the length of their respective migration routes. In short, every part of the skeleton used considerably in flight has been developed to a high degree as an accompaniment to a lengthened line of migration flight.

CAUSE OF HONEY FERMENTATION.—Spoilage of honey, due to fermentative changes, causes some loss to the bee-keeper and tradesman. Messrs. Fabian and Quinet investigating the subject (*Technical Bull.*, No. 92; Agricultural Experiment Station, Michigan State College of Agriculture, East Lansing, Michigan, U.S.A.), find that bacteria, yeasts, and moulds are present in many samples of spoiled honey. A number of these organisms were isolated and re-inoculated into honey to test their effects. Only the yeasts were found capable of causing honey fermentation; good honey frequently, perhaps always, contains yeasts, yet only some honey ferments. It is suggested in explanation of this anomaly that honey is capable of absorbing moisture—up to 30 per cent of its weight—and that when the moisture content rises to about 21 per cent and above the yeasts, the growth of which is inhibited in ordinary honey, are able to develop in the diluted honey.

FOREST NURSERY WORK IN GREAT BRITAIN.—In *Bulletin No. 11*, recently issued by the Forestry Commission, Mr. H. M. Steven discusses, under "Nursery Investigations," work upon which he and others have been engaged during the last few years in connexion with raising young stocks of trees for subsequent planting out to form woods. The investigations deal mainly with the chief coniferous species at present in use in Great Britain. The forest nursery has gradually increased in importance in British forestry since the beginning of the eighteenth century. But it is not pointed out that this factor is due mainly to the woods of the country having been privately owned; that continental practices were unknown; and, finally, that for the private owner wishing to grow coniferous plantations on comparatively short rotations, the nursery and artificial formation of woods by planting may be the best method at present available. Mr. Steven writes: "The purpose of this Act"—the allusion is to the Forestry Act of 1919—"was to increase the forest area by the creation of new forests. This could only be done by planting or direct sowing. To date, the percentage afforested by direct sowing has been less than five, and it will be contrary to the present tendency in European practice if direct sowing becomes the principal method of establishment." This allusion is to the afforestation work of the Forestry Commission. But the author is mistaken in his contention that "the present tendency in European practice" is against direct sowing. Some of the most important post-War mountain afforestation work with conifers is being undertaken by direct sowing over considerable areas in France. Even though netting against rabbits would not be necessary, as in Great Britain, the expense of raising plants in nurseries and afterwards planting them out is regarded as prohibitive, and is only resorted to in special circumstances. The Forestry Commission might consider the advisability of carrying out, over a series of years,

investigations into methods of raising coniferous woods by direct sowing.

YARN STRENGTH AND YARN EXTENSION.—*Bulletin No. 12* from the Indian Central Cotton Committee Technological Laboratory contains a survey by the Director, A. J. Turner, of the very intricate problem of relating yarn strength to the strength of the component fibres. The pioneer work of Bowman and Monie, which is freely quoted in the report, led to the conclusion that only about 10 per cent of the fibre strength is utilised in the yarn. This value is apparently too low on account of insufficient determinations of fibre strength, and corresponding data obtained for Indian cottons by Turner show that the percentage of fibre strength utilised in yarns of various kinds varied from 26·5 to 46·5 per cent (lea test). Such gross inefficiency in yarn structure gave rise to the impression that yarns must break by slippage rather than rupture of the constituent fibres. Turner has disagreed with this opinion in previous papers, and his views are adequately summarised in the present report, which includes photographs to demonstrate that while slippage does undoubtedly occur in the case of loosely twisted yarns, hard-twisted yarns break by fibre rupture. This position has been substantiated by the work of Miss Clegg, who, by employing Bright's technique, was able to determine the proportion of fibres broken when yarns of various kinds were fractured. But if yarn breakage occurs by fibre rupture as well as by slippage, it becomes even more important to explain the inefficiency in yarn strength. This is discussed in terms of ten factors, the most important of which are the transmission of tension by the component fibres; the boundary effect, *i.e.* the progressive decrease in compressional forces from the axis to the surface of the yarn; the effects of group testing; and imperfections of yarn structure such as irregular thickness and twist. The value of the analysis is diminished by the recent appearance of Dr. Lawrence Balls' more fundamental treatise, "Studies of Quality in Cotton."

FORMATION OF RAINFALL.—A recent paper by D. Brunt and C. K. M. Douglas (*Mem. Royal Met. Soc.*, vol. 3, No. 22) opens up a line of investigation which should help to explain the mode of formation of that large proportion of our rainfall which is not due to simple elevation of moist air currents by the interposition in their path of hills or mountains. It puts into mathematical form a relationship, hitherto only vaguely realised, between rainfall and change of barometric pressure. The work of Shaw and Gold on the relation between barometric gradient and wind force established many years ago the important fact that above the first few hundred feet in the atmosphere the motion of the air is such that there is balance between the accelerations brought into play by the motion of the air and the pressure gradient on occasions when the distribution of pressure is steady, and that a close approximation to this balance exists in a very large proportion of actual situations. In the paper under discussion, the difficult task of dealing mathematically with the case of a changing pressure distribution has been attempted, through a realisation of the fact that without a departure from 'balanced' motion convergence of air cannot take place, and consequently an upward current of air such as would give rise to steady rainfall cannot be maintained. An equation of motion is arrived at in which the effects of changing pressure gradient, curvature of the air's path and its acceleration, appear separately. Reasons are found for supposing that in certain cases the effect of changing pressure gradient is greater than that of the other terms. The wind is then made up of the geostrophic wind blowing along the isobars and a component blowing from rising towards falling pressure, this component being proportional to the gradient of barometric change. It is considered that the general tendency for rain to occur in regions of maximum fall, and for fine weather to occur in regions of maximum rise of pressure, may be attributed to convergence and divergence respectively of the 'unbalanced' component of the wind, that is to say, of the deviations from the 'geostrophic' wind. Observational evidence in support of this view is given.

NEW GEOLOGICAL MAP OF SOUTH AUSTRALIA.—The *Annual Report* of the Director of Mines and Government Geologist of South Australia for 1927 contains an account of the new geological map which has been issued by the Survey, together with a useful summary of the distribution and chief characters of the geological formations and references to the leading literature. The map has been printed in colours by photo-lithography, and is on the scale of 32 miles to an inch. Fossiliferous Cambrian rocks are now separated from the generalised Lower Palæozoic, and the oldest tillites have been grouped with Upper pre-Cambrian. The glacial deposits of Permo-Carboniferous age are now shown over a far wider area than was formerly possible. The age of the Leigh Creek coal measures is changed from Jurassic to Triassic as a consequence of recent palæobotanical work. The Cretaceous is divided into two divisions, a Lower marine series and an Upper freshwater series. More prominence is given to the mantle of Recent or Pleistocene material than formerly, mainly for economic reasons. Subterranean structure, however, is indicated by columns of figures showing in various places the downward succession of formations. A greatly reduced copy of the map in black and white patterns accompanies the *Report*, which, together with the colour-printed map, is obtainable from the office of the Geological Survey, Adelaide.

ORIGIN OF THE METAL IN METEORITES.—The peculiar and significant relations between the metallic and silicate portions of stony meteorites have been discussed by most investigators of these remarkable bodies. G. P. Merrill returns to the subject in a paper in which he reviews the divergent opinions of others, and gives the deductions which he has drawn from his own observations (*Proc. U.S. Nat. Museum*, vol. 73, Art. 21, 1928). By means of a series of cogent illustrations it is shewn that in the examples selected the metal was the *last* constituent to congeal and was probably wholly of secondary origin. Reduction of a ferriferous silicate by means of carbon or hydrogen is ruled out of consideration by the complete absence of residual products. Of all the other known constituents the ferrous chloride, lawrencite, seems best to meet the requirements of the case. In a hydrogen atmosphere it is reduced at temperatures not exceeding 400° C. Stony meteorites are certainly volcanic products, and it is possible to conceive the original chloride as one of the volcanic emanations. In terrestrial volcanoes the iron is oxidised almost at once, but in an atmosphere of reducing gases the iron would appear in metallic form. It is noteworthy that Sorby long ago suggested that the metallic constituents of meteorites were introduced into the interstices of the silicates in a state of vapour.

ATOMIC MAGNETISM.—In the September issue of the *Science Reports of the University of Sendai*, Prof. K. Honda gives an account of his theory of the origin of magnetism. He takes the atom to consist of a number of orbital electrons equal to the atomic

number of the element and a nucleus which contains additional electrons in number equal to the difference between the atomic weight and the atomic number, revolving with a high velocity. Just outside these electrons are a number of protons revolving in the opposite direction to the electrons. The outer electrons cannot be magnetised by an external field, but the processional motion produced gives rise to the diamagnetism of the atom. In ferromagnetic atoms the magnetic moment of the nuclear electrons and protons nearly cancel each other and the atom is easily turned by an external field. In paramagnetic atoms neutralisation is less complete and the external field has less effect. In diamagnetic atoms the magnetic moment is large and the field produces no effect on it, the diamagnetism being due to the outer electrons. The author shows that this theory explains many facts not covered by previous theories.

'RESIDUAL HEAT' OF METALS.—Two years ago Prof. Q. Majorana announced that iron, steel, lead, and copper placed, after a previous heating, in a thermostat at the temperature of the air, would retain for weeks a temperature about 0·01° C. higher than that of the thermostat. In the issue of the *Physikalische Zeitschrift* for Sept. 15, Miss M. A. Schirmann, of Vienna, gives an account of her measurements of this effect. Two similar specimens of the metal were used, one heated to redness before polishing, and the other unheated. They were placed in Dewar vacuum vessels immersed side by side in a water bath. The specimen previously heated showed a temperature 0·1° C. higher than the other, but the difference gradually decreased, and after several weeks disappeared. She ascribes the effect to the absorption and adsorption of air by the specimen previously heated, the effect of the heating having been to drive off the gases which the material contains in its normal state. She supports this opinion by showing that during the process of re-absorption the electrical resistance of the specimen increases. She points out that her explanation involves the disappearance of the effect when the metals are placed *in vacuo*.

WIND PRESSURE ON WIRES.—Many researches have been made on the connexion between wind pressure and the velocity of the wind. The construction of the English grid of overhead electric wires has brought the question prominently to the front, and the B.E.R.A. (British Electrical Research Association) have had many researches made in connexion with this subject at the National Physical Laboratory. In a paper read to the Institution of Electrical Engineers on Nov. 8, W. B. Woodhouse gave an interesting account of the work and the definite results that have been obtained. So far as smooth cylinders are concerned, it is now possible to predict with certainty the pressures corresponding to any wind velocities likely to be met with in practice. From theoretical considerations it was known that the ratio of the pressure on the cylinder to the product of the wind speed and the projected area should be a constant, provided that the product of the wind speed and the diameter of the wire remain the same. This has been directly verified by experiment. It has been found that if the diameter of the wire or the velocity of the wind vary, this ratio alters in a definite way. If the pressure is in pounds per square foot and the velocity of the wind in miles per hour, then for large wires the ratio is 0·003, and this is the number generally taken hitherto by engineers. For smaller wires, however, this ratio may be so small as 0·00246, and for very minute wires it may be 0·00360. Experiment shows that this law does not apply to stranded cables, the law derived from dynamic similarity being no longer applicable. Tests made on wooden poles disclosed that the usual design could be greatly improved by suitably modifying it. It has been found that the wind pressure on a strut of circular cross section can be considerably reduced by the addition of a similar strut in its wake. At certain speeds the pressure on a sphere can be reduced by roughening its surface. It has also been shown that the wind pressures on two struts of equal mechanical strength may be in the ratio of 6 to 1, depending on the shape of their sections.

MICRO-IDENTIFICATION OF ISOMERS.—A recent number (vol. 3, No. 8) of the *Bulletin of the Chemical Society of Japan* contains a paper by M. Migita on the micro-identification of the three isomeric xylenes in their mixture. Xylene is present in most samples of petroleum and wood-spirit and it is an important constituent of solvent naphtha, but the identification of *o*-, *m*- and *p*-xylenes in small quantities is a matter of considerable difficulty. From this paper it appears that traces of *m*- and *p*-xylene can be identified by the colour reactions given by their trinitro-derivatives in alcohol or acetone solution on the addition of alkali, while *o*-xylene can be detected as the sodium sulphonate by microscopic examination of the crystals.

REACTION BETWEEN ZINC AND CARBON MONOXIDE.—The *Journal of the American Chemical Society* for October contains a note by R. W. Millar on the reaction between liquid and gaseous zinc and carbon monoxide. From thermodynamical considerations it appears that, except at very low partial pressures, zinc vapour and carbon monoxide should react to give zinc oxide and carbon at about 700°, which is the temperature of the condenser used in zinc smelting. Experiments were carried out in order to ascertain whether the rate of direct reduction of carbon monoxide by zinc was appreciable, but the results indicated that, in the absence of a catalyst, the reaction $CO + Zn = ZnO + C$ is very slow at 600°-700°. It was found, however, that zinc reduces carbon dioxide rapidly at this temperature. The production of zinc oxide in the condenser seems to be due, therefore, to the oxidation of the zinc by carbon dioxide or by water vapour, both of which are present in considerable quantities during the smelting operations. Zinc may be safely distilled in carbon monoxide provided that the apparatus is free from iron.

ACCELERATED TESTS OF ORGANIC PROTECTIVE COATINGS.—The *Bureau of Standards of the U.S.A.* has recently issued Research Paper No. 1, which consists of an account by P. H. Walker and E. F. Hickson of the accelerated tests applied by the Bureau to paints, varnishes, lacquers, etc. The most important causes of the decay of such protective coatings are light, moisture, and temperature changes. An enclosed carbon arc is used as the source of light for test purposes in preference to a mercury arc, since the latter emits a considerable amount of radiation not present in sunlight. Test panels are also exposed to a spray of warm water, to low temperatures, and to various gases such as ozonised air. The extent of disintegration is determined by measuring the permeability to air and water vapour, and by testing the insulating properties of the film. The apparatus used for these purposes is also described. So far as can be judged by visual observation, the nature of the breakdown of a coating by artificial means is similar to that of a breakdown caused by weathering, but it is not easy to know the time of weathering equivalent to given standard tests owing to the variations of the weather.

The Kimberley Meeting of the South African Association for the Advancement of Science.

THE twenty-sixth annual meeting of the South African Association for the Advancement of Science was held at Kimberley on June 29–July 4, 1928, under the presidency of Sir J. Carruthers Beattie. The meeting was well attended, and eighty-six papers were read. Joint meetings of several sections were held. The South Africa medal and grant were presented to Dr. H. H. Green at the conclusion of the presidential address. A popular, illustrated lecture was given by Prof. P. Kirby on "Primitive and Exotic Music." There was a reception by the Mayor and city councillors in the City Hall, and visits to various places of scientific interest in Kimberley and the neighbourhood.

The president, Sir Carruthers Beattie, took as the subject of his address "Some Possible Extensions of the Activities of the Association." He gave an account of the first magnetic survey of South Africa, and emphasised the necessity of repeating a magnetic survey at not too long intervals. A re-survey has recently been begun in South Africa and its importance was indicated, particularly in regard to aviation and to the location of minerals and oil. The study of the problems of African peoples was indicated as a field for further work. Much research had been done in practically every field, but more was needed. The effect of present and prospective African industrialism on European and other industries might be investigated. As a body the Association might undertake the co-ordination and dissemination of the knowledge already available. The question of the extent to which the Bantu was capable of development affected not only South Africa, but also the world. The presence and determination of the European to remain in certain parts of Africa created the native question from the European point of view and the European question from the native point of view. The possibility of persistence of the white in South Africa, as occurred in other continents, needed investigation. Whites and natives both so far flourished, but how these non-homogeneous elements were to continue needed research. The possibilities were racial amalgamation resulting in a new race, or domination of one race by another, or development of the races on their own lines. The domination policy was considered as never succeeding permanently. The Bantu were assimilating European ideals and culture rapidly. Guidance in the science of government would be necessary. The possibility of development of the Bantu to a degree comparable with our own, and the assumption that the white knew best what was good for natives, needed consideration. The problems of population and food supply in parts of South Africa, of the second Oriental generation in Africa, and the effect of the native in European industry, also were indicated for research. "By research, discussion, and publication we can make a contribution of value towards the solution of Africa's greatest problem."

The presidential address to Section A was given by Dr. J. S. van der Lingen, his subject being "Garnets." Garnets as associates of diamonds were noted. The classification as aluminous and non-aluminous garnets was shown as applying to 'ideal' garnets, those found being isomorphous mixtures. The spectroscopic examination of garnets was described in detail. From numerous examinations it was concluded that yttriferous garnets are not rare in South Africa. The name proposed for this type of garnet, namely, a spessartine containing yttrium, is emildine, the limitation being that molecules of uvarovite must be absent and the molecule of pyrope either absent or a trace. In another type of garnet from other localities the molecule of pyrope was conspicuous. Magnesium and chromium were the determining elements in garnets derived from kimberlite. Yet another type of garnet, designated erinadine, contained both pyrope and uvarovite; but unlike the pipe garnets, they also contained yttrium. The absorption spectra of garnets were discussed and the application of these methods of examination of garnets to the detection of the presence of kimberlite pipes was indicated.

"The Liquid Fuel Problem" was the subject of Prof. J. Smeath Thomas's address to Section B. Adequate and continuous supply of liquid fuel was essential for national welfare. The general tendency to use oil instead of coal was shown by ship construction and mechanised transport. The possible exhaustion of the world's oil deposits was discussed, and it was concluded that there was no immediate danger. In non-oil producing countries fears in this direction were really due to political and strategic considerations. The oil position in the United States is such that control of the world's petrol reserves must pass from it, just as control of the coal market has passed from Great Britain. Petroleum substitutes and admixtures were considered. Alcohol mixed with petrol and benzene provided an excellent motor spirit. The production of fuel alcohol from home-grown materials was of special importance in South Africa, where large quantities of waste vegetable products and rank grasses were available. Sawdust and wood waste, ethylene and acetylene also were considered. The production of liquid fuel from oil shale and other carbonaceous rocks by destructive distillation was considered, and the value of by-products such as ammonium sulphate, in addition to the oil, was considerable. Coal as the source of future supplies of liquid fuel was of the greatest importance, and South Africa had abundance of suitable coal. The various methods of producing liquid fuel from coal—by low temperature carbonisation, the Bergius process, conversion into water gas, and synthesis of alcohols and hydrocarbons from this by catalysts—were discussed. The establishment of a Fuel Research Institute was urged.

In his presidential address to Section C, Mr. J. S. Henkel dealt with "The Relation of Vegetation to Water Supply in Southern Rhodesia." In Rhodesia summer rainfall prevails. Grassland and woodland are the principal types of vegetation, the latter being either close types (high forest) or savannah. About 60 per cent of the Colony is woodland. Most of the savannah trees are deciduous. Where human influence is not conspicuous, crowded trees of large dimensions and tall growth occur in high forest, small trees in savannah. Native shifting cultivation has caused much deforestation, but scrub is largely scanty regrowth of savannah. The heaviest rainfalls are along the eastern boundary, and rainfall distribution and vegetation maps do not coincide. Five groups of grasslands are differentiated. Extensive level areas occur on the main plateau, which become waterlogged in summer. Grass is the climax type. When drainage occurs, trees take possession. The second group occurs on ridges or narrow plateaux where excessive water supply in the growing season excludes trees. The third group has soil sufficient for grass but not for trees. The fourth is where neither excessive water supply nor shallow soil is present. The fifth group is along the eastern border mountains, the grassland being of an ancient type. Indigenous forest encroaches on grassland if not disturbed by man. Close

type or high forest is confined to areas of abundant rainfall and high elevation. They are not extensive and are mostly evergreen. Streambank forests of evergreens occur at all elevations where there is permanent water. Lists of the trees in the various sites were given. The western high veld showed *Baikiaea plurijuga* and *Copaifera coleospermia* were dominants, but in parts invasion by *Brachystegia* and *Berlinia* was occurring. Ridges at heads of valleys with eastern and southern aspects had *Uapaca* as the dominant. It formed abundant humus, hence deforestation by natives occurred. The mountain Acacia group was described and the *Brachystegia-Berlinia* savannah association. In the low veld, *Copaifera mopane* is the dominant tree. The type species of savannah forest change with elevation and therefore with water supply. The study of vegetation and its trend may indicate whether the climate is becoming wetter or drier, an important problem to South Africa.

The president of Section D, Prof. P. J. du Toit, spoke of "The Significance of Zoology in Veterinary Science" in his address. The early history of veterinary science dated to 4000 years ago, but modern science began in the eighteenth century. Outstanding discoveries of the late nineteenth century were those of the trypanosome causing surra, and of the Babesia responsible for redwater in cattle. These illustrated how veterinarians seeking the cause of disease had to focus their attention on the microscopic and invertebrate world. The study slowly emerged from empiricism and gradually began to embrace biology as a whole. The Protozoa as disease excitants had led to intensive study of the group, accompanied at first by the creation of numerous species, now reclassified under relatively few names, the rest being synonyms. The characters of these standard forms and their synonyms were given. The Piroplasms were similarly considered. Among the Metazoa, the veterinarian and zoologist have common ground in the study of the Cestoda of domestic stock and in the search for intermediate hosts of other parasitic worms. For the determination of such life histories a good knowledge of zoology is essential. A necessary part of the equipment of every veterinarian is a knowledge of the systematics, anatomy, and biology of insects, mites, and ticks. In no group was the common interest of veterinarian and zoologist more clear than in the vertebrates. Anatomy, physiology, and embryology all demanded the comparative method of study for the best results. Many species of mammals were carriers of organisms pathogenic to domestic animals. The diseases of birds are assuming greater importance yearly, as are those of fish. In veterinary education in South Africa an attempt has been made to break away from the more stereotyped course of the older schools and to give to the students the broad scientific bases necessary. Special courses in protozoology, entomology, and helminthology have been instituted. It is hoped that adequate recognition of the value of zoology will enable the younger generation of veterinarians to maintain a leading position for South Africa in veterinary science.

"The Study of Social Structure" was the subject of the address by Prof. T. T. Barnard to Section E. South Africa was a great field for the study of cultural anthropology, and there was urgent need for sympathetic knowledge of the social forms of the Southern Bantu. The study of man's socialised behaviour overlapped with other branches of anthropology. The main divisions of anthropology are ethnography, ethnology, and social anthropology. The methodology of ethnography was discussed, and need for both field work and theoretical treatment by the same investigator emphasised. Both ethnology and social anthropology take their subject matter from ethnographical records. The ethnology of the Southern Bantu was the historical analysis of their distribution, development, history, evidence for possible external influences, and transmission of cultural traits from group to group, of which illustrations were given. In social anthropology there was the search for general principles underlying the varieties of cultural form. Historical reconstruction of the prehistoric past is the legitimate aim of ethnology, but the principles of cultural development could only be demonstrated by inductive study of social change. The method of studying cultural variation and development must be inductive. Social anthropology is mainly concerned with the standards of social behaviour, and their analysis is one that will explain the forms as expressions of the needs of the society in which they occur. The study of social groupings is fundamental for the discussion of adjuncts of group differentiation. The three main problems are the actual distinctions existing between individual members of society, the operation of some criterion of similarity for the formation of social groups and the expression of group membership in the behaviour of its constituent members by the observance of group obligations. As examples, problems of kindred differentiation were considered and, in particular, the four methods of incest extension among the Bantu-speaking peoples of Southern Africa.

The presidential address to Section F was delivered by Dr. M. Boehmke, who dealt with "Some Social Implications of the Poor White Problem." It was pointed out that in South Africa there was a group of persons known as 'poor whites,' who were becoming an ever-increasing burden to the population. The poor white problem was considered to be due to remediable economic and social causes, such as the mental attitude towards manual labour, the presence of a coloured race at a lower level of civilisation, inheritance laws, exploitation by landowners, geographical and social isolation, laziness, misfortunes such as droughts, and, above all, ignorance. The solving of the problem of the poor white was essential. Early marriage and intermarriage had produced much feeble-mindedness. The non-intelligent ballot must be considered. The social whole must assume responsibility. The mental survey was of much use, but the social survey, organised along proper lines, was considered to be the best mode of attack. Such a survey must be local, definite, and public. Every house, family, and organisation must be included. Co-ordination and intensification of all uplifting efforts would eliminate the poor white problem in a generation, it is believed. The positive force for good would be appreciable when the poor white was brought to a normal position in life and he should become an asset to the country.

A few remarks may be made on the subjects discussed in the various sections:

In Section A, mathematical and engineering problems were to the fore, the maximum and minimum values of a function determined by the method of undetermined multipliers, the elastic impact of a sphere on a plane fixed surface and graphical solutions of electrical engineering problems being discussed.

In Section B an apparatus for observing changes in electrical conductivity in immersed paint films was described, a useful account of the medicinal springs of South Africa was given, the geological problems connected with the occurrence of kimberlite, and with the formation of red soil and of black vlei soil from dolerite in Rhodesia were discussed.

In Section C several papers of veterinary interest were taken at a joint meeting with Section D. These dealt with the poisonous plants, *Bowiea volubilis* and

Cucumis myriocarpus, rapid agglutination tests in calf paratyphoid, and *Salmonella* infections in canaries. Mycological papers were given on various new South African fungi, South African *Salicornia* and some natural hybrids were described, valuable practical notes on the reclamation of drift sands were given, very interesting accounts of plant indicators and of the forest types in the Knysna region were presented, and pharmacologists found much interest in an account of South African medicinal and poisonous plants.

A wide range of subjects was discussed in Section D. Many topics of interest to veterinarians and pathologists, as well as to zoologists, were considered, among these being the experimental induction of infection with *Trypanosoma vivax* in sheep and goats, gross invasion of the liver of lambs by cysticerci, fat necrosis, fatty infiltration of the liver, and bent-leg in sheep. East Coast fever and immunity therein was also considered, and some interesting facts regarding longevity of the brown tick without feeding were given, the latter having some significance in explaining sporadic outbreaks of disease. The adhesion reaction in trypanosomiasis and new methods in diphtheria prevention were also considered, and the culture of *Crithidia melophagia* from the blood of South African sheep described. The Protozoa found in South African soils, wherein a series of comparisons of the protozoal fauna of soils from the Knysna Forests was made, and an account of some new plant-inhabiting Herpetomonads were of much interest. A case of human infestation by *Armillifer armillatus*, showing southernward extension of the range of the Porocephalid parasite, was described. A series of papers dealt with crimps and quality estimations of grease wool, the standardisation of quality numbers and fibre variation in the merino. Some valuable observations on the formation of non-nucleated blastospheres in the eggs of a spider were detailed. The natural history of the 'Loerie' (*Turacus*) in the Knysna Forests and its rôle in seed dispersal were described. Some physiological papers dealt with the chromatic function in *Xenopus*, excitement pallor in chameleons, the relation of electrolytes to cardiac rhythm in *Octopus* and *Palinurus*, the hydrogen-ion concentration of the waters around the Cape Peninsula. A study of the zoogeographical relationships of certain insect groups was of much interest.

In Section E, stone implements and their significance were to the fore, the stone culture of Victoria West, implements from Howieson's Poort and stone bracelets being described. The Middle Stone Age in South Africa was defined and an account given of the implements in Sir Langham Dale's collection. Strandlooper excavations at Knysna were also described. The political organisation of the Bechwana, the religion of the Bapedi, and the magic medicine of the Hottentots also evoked interest.

In Section F, philosophy and economics were the chief topics. The philosophers discussed some aspects of the approach of philosophy and science, the social significance of art, the psychology of advertising, the nature of perception, and there was a joint meeting with Section D for a paper on industrial psychology. Other papers dealt with the Stanford revision vocabulary test, the first results of the Porteus maze test to native school children. Much interest was aroused by notes on some native budgets collected in Durban.

The next annual meeting of the Association, under the presidency of the Hon. J. H. Hofmeyr, will be held in July 1929, when the South African Association for the Advancement of Science will merge with the British Association, members of which will meet in South Africa as guests of the South African Association.

H. B. F.

The Evolution of Human Races.

THE Huxley Memorial Lecture of the Royal Anthropological Institute was delivered by Sir Arthur Keith in the lecture hall of the Royal Society on Tuesday, Nov. 27, at 8.30 p.m., when Prof. J. L. Myres, president of the Institute, took the chair. Sir Arthur Keith took for his subject "The Evolution of Human Races." He traced Huxley's career as an anthropologist, and said that in his opinion, his final conclusion that the chief types or races of existing mankind can be reduced to four, is still the most acceptable working hypothesis. Huxley's four chief types are represented by the fair people of Europe (his Xanthochroi), the negro of Africa, the Mongol of Asia, and the aborigine of Australia. The less differentiated types or races Huxley regarded as intermediate in characterisation to his main types, and was disposed to look upon them as having arisen by various degrees of miscegenation of the main types.

That peoples have arisen by the mixing of diverse races cannot be denied, but the chief problem which has to be solved is the origin of the chief types, which cannot be explained by any theory of hybridisation. The only valid explanation is Darwin's, which requires restatement in the light of modern knowledge. The theory of the evolution of races as thus restated includes the co-operation of a triple mechanism: (1) physiological processes which regulate the growth of the human body and determine its racial characterisation; (2) an isolating or segregating mechanism, which tends to preserve a local people in its purity, and thus permits physiological processes to work undisturbed through many generations; this isolating mechanism is found to be mainly physiological, but physical barriers also isolate; (3) a selective mechanism represented by changing environment and also by inter-racial competition. If these evolutionary means are sufficient to produce the four chief racial types, they could also have given rise to all secondary and intermediate races. The conclusion was reached that hybridity has played only a subsidiary rôle in the evolution of differentiated races.

If evolution is true, we ought to find human races in every stage of differentiation. This is what anthropological investigation is now revealing. There are not only Huxley's main or completely differentiated racial types, but there are also nationalities and peoples which represent every stage in the process of differentiation from a zero-point upwards. To races in which every individual is differentiated and can be recognised at sight by physical appearances, Sir Arthur applies the term pandiacritic. If 80 per cent and upwards of the individuals are recognisable, he proposes the name macrodiacritic; if more than 30 but less than 80 per cent, he suggests the name mesodiacritic; if less than 30 per cent, he names them microdiacritic races.

In conclusion, Sir Arthur applied this more plastic conception of race to the national and racial problems of Europe, in particular to those of the British Isles. Huxley rightly regarded the English, Welsh, Scottish, and Irish nationalities as mixtures of the same two racial stocks—the Nordic and Mediterranean of Europe—and they, from a zoologist's point of view, he held have no claim to racial status. In a lecture given in 1870 he stated: "If what I have to say in a matter of science weighs with any man who has political power, I ask him to believe that the arguments about the difference between

Anglo-Saxon and Celts are a mere sham and delusion."

A truer conception of the manner in which human races are evolved must lead to a reversal of Huxley's verdict. A nation must be regarded as an incipient race; it was only when this biological conception is applied that national behaviour can be explained. The men who settled in Britain at various periods of time, although representing different branches of European humanity, had in their bodies and brains the same ancient machinery of evolution. When diverse racial elements are assembled on new territory—provided the diversity be not too great—the race-building machinery at once comes into operation. The new assemblage starts from zero-point and works unconsciously towards complete racial differentiation. The conditions of modern civilisation make the smooth working of the ancient machinery of racial evolution an impossibility.

At the close of the lecture Prof. J. L. Myres presented the Huxley Memorial Medal for 1928 to Sir Arthur Keith.

University and Educational Intelligence.

Cambridge.—Mr. J. F. Cameron, bursar and formerly senior tutor and lecturer in mathematics at Gonville and Caius College, has been elected Master of the College in succession to Sir Hugh Anderson, who died in Nov. 2.

London.—Mr. R. G. H. Clements has been appointed as from Dec. 1 to the Maybury chair of highway engineering tenable at the Imperial College—City and Guilds College. Mr. Clements studied at Heriot-Watt Engineering College, Edinburgh, where he obtained the diploma in civil engineering in 1904, and at University College, Southampton. He has worked as an engineer on public bodies and has held various appointments in the Roads Department of the Ministry of Transport.

The title of emeritus professor in the University has been conferred on: Prof. J. Norman Collie, on his retirement from the University chair of organic chemistry tenable at University College; Prof. L. W. Lyde, on his retirement from the University chair of economic geography tenable at University College; Prof. A. W. Porter, on his retirement from the University chair of physics tenable at University College. The title of emeritus professor of philosophy at University College has been conferred on Prof. G. Dawes Hicks, on his retirement from the chair of philosophy at that College.

Sir Dugald Clerk will distribute the awards and give an address at the annual prize distribution of the Northampton Polytechnic Institute, London, E.C.1, on Friday, Dec. 7, at 7.30 p.m.

The tenth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation, N.Y. In 33 articles, schools of medicine and institutes and departments of medical studies in all parts of the world are described, and their courses of instruction outlined. As in previous studies, the text is lavishly illustrated with plans and reproductions of photographs of the buildings and laboratories. An article entitled "How to Use a Medical Library" gives valuable advice as to the sources the investigator should consult to obtain the literature of his subject. The articles are not copyright and may be utilised in any way.

The Martell Scholarship (£130 per ann.), the Fairfield Scholarship (£150 ann.), per and the Denny Scholarship (£75 per ann.), all in naval architecture, and the Parsons Scholarship (£150 per ann.) in marine engineering, will be offered for competition in 1929 by the Institution of Naval Architects. The Denny Scholarship is open to boys less than nineteen years of age (British subjects) who have not yet begun their apprenticeship; the other scholarships are open to British apprentices or students between the ages of eighteen and twenty-three who have not yet entered upon a university course. Particulars can be obtained from the Secretary, Institution of Naval Architects, 2 Adam Street, Adelphi Terrace, London, W.C.2.

The New Education Fellowship, an international organisation of educationists, teachers, and parents in all parts of the world, is holding its fifth International Conference at Elsinore, near Copenhagen, on Aug. 8–21, 1929, on the subject of "The New Psychology and the Curriculum." At the Fellowship's last Conference, held at Locarno, more than 1200 members were present from 42 different countries. Examinations will form the subject of concentrated study at the Conference, and three public meetings will be held, at which representatives from various countries will bring forward the results of their investigations in this field. A special study will be made of the Danish Folk School. Further details of the Conference can be obtained from the headquarters of the New Education Fellowship, 11 Tavistock Square, London, W.C.1.

The Science Masters' Association will hold its annual meeting at Cambridge on Jan. 2–5; the president, Prof. A. C. Seward, is to deliver his address on the evening of Jan. 2. The programme includes lectures by Prof. A. S. Eddington on the interior of a star, by Prof. T. M. Lowry on the arrest and promotion of chemical change, by Mr. J. T. Saunders on raising animals in cultures and their use, by Prof. E. V. Appleton on large scale optical experiments, by Sir William Pope on colour photography, and by Prof. J. Barcroft on hæmoglobin. There will be facilities for visiting the University laboratories, the Cambridge University Press, and also a sugar beet factory at Ely, and a trade exhibition of books and apparatus will be open throughout the meeting. Particulars as to accommodation, etc., can be obtained from the honorary secretary, Mr. I. M. Bankes-Williams, Lincoln House, London Road, Harrow.

The annual conference of the Geographical Association will be held on Jan. 3–7, at the London School of Economics, Houghton Street, W.C.2, under the presidency of Sir Henry Lyons, who will deliver his presidential address, entitled "The Geographer and his Material," on Jan. 4. The programme includes lectures of Prof. J. Sölch of Heidelberg, on geomorphological problems of the Eastern Alps, by Dr. P. W. Bryan, of University College, Leicester, on natural environment related to human activity in the corn belt of North America, by Prof. C. B. Fawcett on the balance of urban and rural populations, and by Dr. Vaughan Cornish on linguistic frontiers in Central Europe. There will also be discussions on sketch maps for senior and central schools and on educational reorganisation and the teaching of geography, to be opened respectively by Miss E. G. R. Taylor and Mr. E. J. Orford, both of Birkbeck College, London. A reception will be given by Dr. Henry S. Wellcome at the Wellcome Historical Medical Museum, Wigmore Street, W.1, on Jan. 5. A publisher's exhibition of books and maps will be open during the meeting. Programmes of the meeting can be obtained from the Association, 11 Marine Terrace, Aberystwyth.

Calendar of Customs and Festivals.

December 6.

ST. NICHOLAS.—Born at Patara, a city of Lycia, and, though a layman, for his piety made bishop of Myra. He died in A.D. 343. The cult of St. Nicholas is specially connected with children and young people, hence many observances connected with his festival were transferred, some to Holy Innocents (Dec. 28) and some to Christmas. Various legends were current to account for this connexion. It is related that the innate piety of St. Nicholas was such that from the time of his birth he abstained from his mother's breast more than once on Wednesdays and Fridays.

More familiar is the story of the two youths who came to visit St. Nicholas at Myra while on their way to be educated at Athens, and were murdered by an innkeeper. The dismembered bodies were salted and placed in a pickling tub with some pork. On the saint, who had been informed of this event in a vision, upbraiding the innkeeper with his infamy, he repented, and the youths, miraculously made whole and brought to life at the intercession of the saint, stepped from the tub and prostrated themselves before him. Other versions make the scholars three in number. Hence originated the emblem of St. Nicholas—the naked children and the tub—and hence all schoolboys came to regard him as their patron. When a boy was hard pressed in a game and wished to cease play for a short period for any reason, the cry of 'Nic'las' secured him a brief respite, a survival of a medieval form of appeal to an overlord which still obtains in the Channel Islands, where the right of the *Clameur* or *Cri de Haro* is traditionally said to have been conferred upon the inhabitants by Rollo or Rou, Duke of Normandy. Under this privilege, anyone who considers himself wrongfully treated can secure immediate cessation of the act, pending investigation, by kneeling in the presence of two witnesses and crying 'Haro! (Ha Rou) Haro! à mon aide, Mon Prince, on me fait mal.'

A further manifestation of St. Nicholas's interest in children was the custom of making gifts to them on the morning of the saint's festival. These were said to come from St. Nicholas. This custom has now been transferred to Christmas. It has its legendary explanation in a story that St. Nicholas cast purses of money by night through the bedchamber window of a poor citizen to serve as portions for his three daughters and save them from prostitution. Hence also his patronage of virgins.

The saint's patronage of scholars was extended to all clerks, and thus he became the patron saint of parish clerks. Thieves also, as coming under his protection, were known as 'St. Nicholas's Clerks.'

In his connexion with the sea, and his protection of sailors, St. Nicholas has assumed the function Poseidon or Neptune. A chapel in Minorca dedicated to St. Nicholas was hung with votive pictures by sailors who had suffered shipwreck, in gratitude for their escape. The custom was general throughout the Roman Catholic world and recalls the *votiva tabella* to which Horace refers (*Odes* i. 5). Churches dedicated to St. Nicholas generally stood within sight of the sea. The corposant or St. Elmo's light which appears on the sails and masts of ships in stormy weather is in the Eastern Mediterranean also considered a mark of St. Nicholas's protection.

THE BOY BISHOP.—The observation of Dec. 6 as a festival in honour of St. Nicholas among schoolboys was signalised by the election of one of their number as a 'bishop.' This seems to have been especially a custom of the grammar schools. Sports took place in which, so early as Edward I., it was necessary to prohibit the inclusion of tournaments. According to a record of Wye School, it was customary for an offering of pence and a cock to be made to the master on St. Nicholas's day. The custom of electing a boy bishop was sometimes connected with the memory of Gregory the Great, also a patron of scholars. In addition to the sports, processions headed by the boy bishop took place. In Franconia, where the deacons as well as the bishops were elected from among the boys, subsidies were demanded, not begged, in the name of the bishop in a house-to-house visitation. Processions of a similar kind took place in England, the boys receiving presents for their singing, and the blessing of the bishop. The processions through the streets were forbidden in London by proclamation in 1541.

These observances among schoolboys were a survival of what had originally been a purely ecclesiastical practice. It was the custom for the cathedral choir boys to elect one of themselves as bishop to hold office until Holy Innocents' Day. The Boy Bishop, dressed in full pontifical robes with mitre and pastoral staff, often at very great expense, as is shown by the accounts, conducted a service in the Cathedral, and preached a sermon, which had been written for him. The choir boys occupied the stalls of the Church dignitaries, who fulfilled menial offices and occupied the lowest seats. During his tenure of office the Boy Bishop was supposed to bestow any preferments which became available—sometimes on the Continent his privileges included the appointment of civil officers and police—and if he should die within the period, he was buried with the full honours of a bishop. That the ceremony sometimes degenerated into buffoonery is suggested by records which show that a fool in the usual costume with inflated bladder was included in his train. In the proclamation of Henry VIII. forbidding the procession in London, reference is made to the personation of women, and in some nunneries little girls seem to have performed the offices.

Evidences of the election of the Boy Bishop in medieval times on the Continent and in England are numerous. Salisbury provides the most detail in the "Processionale ad usum . . . Eccles. Sarum." 1566, in which an elaborate service set to music gives the whole ritual to be observed by the Boy Bishop on the eve of Holy Innocents. This was at one time thought to be the only instance in England, but the custom has been traced in a number of the cathedral cities, collegiate churches, and larger towns. It is not improbable that it was even more widely spread, and may, as has been stated by some writers, have once been celebrated in every parish. If this was really the case, it was probably in origin a popular festival taken over by the church. This would account for the wearing of vizards alluded to by some writers, and for the inclusion of women and girls in an institution essentially masculine. Apparently so early as the Synod of Constantinople in 867 there existed a practice at the courts of princes of decking out a layman as a bishop, and an attempt was then made to suppress the custom. Probably, like the Scottish 'Abbot of Unreason,' this bishop was a Lord of Misrule such as was elected at certain seasons, but especially at Christmas—a form of the more popular masquerade or carnival, when all authority was abrogated, as in the Roman saturnalia, and ultimately to be traced to the periodical observances found among primitive peoples when all taboos and regulations, particularly those affecting sexual relations, are deliberately ignored.

Societies and Academies.

LONDON.

Royal Society, Nov. 15.[1]—**F. A. Jenkins and H. de Laszlo**: Structure of the violet bands of silicon nitride. The analysis shows a marked isotope effect for $Si^{28}N$, $Si^{29}N$, and $Si^{30}N$.—**R. A. Fisher**: The general sampling distribution of the multiple correlation coefficient.—**F. W. Carter**: On the stability of running locomotives. The inherent riding qualities of locomotives are discussed from the point of view of their natural tendencies, whether to seek the centre of the track or to deviate therefrom. The locomotive of one truck or axle group is generally unstable. In the locomotive of two trucks, these have regions of stability, limited by running speed and by the forces between main and auxiliary trucks.—**A. C. Menzies**: Ground terms in the spectrum of nickel II and proposed standard wave-length in the Schumann region. The method already described of obtaining spectrograms with exposures of the order of 1/100 second in the Schumann region (by fusing wires) is particularly well suited to the investigation of ground-terms, and has been applied to elucidate those of nickel II.—**J. M. Whittaker**: On the principle of least action in wave-mechanics. The connexion between Dirac's ave equations and the equations suggested by the uthor in a recent paper are discussed.—**H. Dingle**: he spectrum of doubly ionised fluorine (F III). omparison of the spectrum with that of singly onised oxygen shows close correspondence, with a w exceptions.—**J. A. V. Butler**: The equilibrium of eterogeneous systems, including electrolytes (Part 3). n equation is deduced for the variation of the dsorption of a substance dissolved in a more polar nedium with the electric field at the interface.—**. R. Goldsbrough**: The tides in oceans on a rotating lobe (Part 2). The method of Part I of this paper is pplied to two types of flat rotating sea; a semi-ircular basin, deepest in centre and shelving towards ircumferential edge, and a flat semicircular basin of niform depth.—**T. Bradshaw and G. H. Livens**: The formula for the optical rotatory dispersion of uartz.—**H. T. Flint**: The new metric of Einstein and he wave equation.—**A. Robertson**: The strength of ubular struts.—**G. S. Adair**: A theory of partial smotic pressures and membrane equilibria, with pecial reference to the application of Dalton's law o hæmoglobin solutions in the presence of salts. The smotic pressures of hæmoglobin solutions in equilibrium with solutions of diffusible salts have been neasured and correlated with determinations of the membrane potentials, and the distribution of diffusible ons. Within certain ranges of hydrion, salt and rotein concentrations, a modified form of Dalton's aw of partial pressures is applicable for analysing the bserved osmotic pressures in terms of the diffusible on pressure difference, and the partial osmotic pressure of the protein ions. The value 67,000 obtained or the molecular weight hæmoglobin in physiological salt solutions agrees with that previously determined for hæmoglobin in distilled water.—**A. T. Waterman**: The effect of electric fields on the emission of electrons from conductors. An examination of the Schottky effect from the point of view of the Sommerfeld electron theory of metals. Accurate experimental data on the Schottky effect should therefore distinguish between the Sommerfeld theory and the classical.—**W. Mandell**: (1) The change in elastic properties on replacing the potassium atom of Rochelle salt by the ammonium group. The two substances are isomorphous. Their densities differ considerably, whilst smaller changes take place in the optical rotation, the refractive indices, and the size of the space-lattices and of the interfacial angles. The ammonium salt is less elastic than the potassium salt, the deformation magnitudes being fairly uniformly increased in all directions. Comparison of the elastic curves shows that the inter-atomic forces in both are very similar and that the potassium atom is a sort of 'key' atom in the molecule. (2) The determination of the piezo-electric moduli of ammonium seignette salt.—**A. M. Tyndall, L. H. Starr, and C. F. Powell**: The mobility of ions in air. Part 4. Investigations by two new methods. At long ages, the positive ions have mobilities distributed over a small range with a mean value of about 1·25, which is independent of the humidity of the air. There is no evidence of initial positive ions in very dry air or in pure nitrogen. If any are formed, they nearly all transform in less than 1/100 sec. The mobility of both the negative and positive ions in air containing alcohol vapour is independent of the age of the ions from 1/25 to 2/3 sec.—**A. M. Tyndall, G. C. Grindley, and P. A. Sheppard**: The mobility of ions in air. Part 5. The transformation of the positive ions of short ages. An air blast method was used. A small quantity of ozone produces a marked increase in the rate of transformation; this effect may explain the different results obtained by various observers using different methods. The rate of transformation is greatly retarded if, before entering the air blast, the ions are formed in an atmosphere containing the vapour of certain alcohols of the aliphatic series.—**L. J. Freeman**: The spectrum of doubly ionised nitrogen (N III).—**W. R. Dean**: Fluid motion in a curved channel. The motion of fluid forced under pressure round the space between concentric circular cylinders may become unstable for a symmetrical disturbance. In certain cases the disturbance may be that which actually ensues when steady motion breaks down. It cannot persist in a straight channel. This effect of curvature may explain why there is not in a curved pipe a sudden increase in loss of head in the neighbourhood of the critical velocity.—**H. E. Watson and A. S. Menon**: The electrical conductivity of thin oil films. Part 1.—**W. Kapucinski and J. G. Eymers**: Intensity measurements in the secondary spectrum of hydrogen.—**E. Rudberg**: Some remarks concerning the production and absorption of soft X-rays and secondary electrons. The number of photoelectrons produced for one quantum of radiation absorbed is of the order unity. This result, with efficiency measurements on soft X-ray production using the photoelectric method, shows that the yield of such radiation when metals are bombarded with electrons of a few hundred volts' energy is extremely small. A very much larger portion of the energy of the bombarding electrons reappears in smaller units as energy of secondary electrons, a great part of which are probably initially free conduction electrons of the substance.—**B. Swirles**: The internal conversion of gamma-rays. Part 2.—**R. S. Bartlett**: The increase in thermionic currents from tungsten in strong electric fields. Experimental results for the increase of thermionic currents with applied electric field at constant temperature show only general agreement with theory. Surface impurities in the cathode exert a marked effect.—**L. H. Thomas**: On the rate at which particles take up random velocities from encounters according to the inverse square law.

[1] Continued from p. 830.

Physical Society, Oct. 26.—**Allan Ferguson and Jas. P. Andrews**: An experimental study of the anticlastic bending of rectangular bars of different cross-sections. A method is described for the survey of the

surface of a beam bent by couples, with special reference to the study of the curvatures in and perpendicular to the plane of bending.—**B. S. Smith and F. D. Smith**: An instrument for the production of known small high-frequency alternating electromotive forces. A portable instrument for the production of known electromotive forces, variable in frequency from 10 to 50 kilocycles and in magnitude from 0·0076 to 15,000 microvolts, is described. It is intended for the calibration of amplifiers and the measurement of the strength of wireless signals of long wave-length.

Mineralogical Society, Nov. 6.—**F. A. Bannister**: The so-called 'thermokalite,' and the existence of sodium bicarbonate as a mineral. The composition of a large collection of saline incrustations collected by Dr. Johnston-Lavis about 1889, has been investigated. He labelled them 'thermokalite,' but they are found to be a mixture of trona, thermonatrite, thenardite, and free sodium bicarbonate; no potassium salts are present. The name nahcolite is proposed for naturally occurring sodium bicarbonate. These incrustations were found lining the walls of a cuniculus near the Stufe di Nerone, Baia, Naples, Italy; their mode of occurrence is discussed from a physical-chemical point of view.—**W. A. Wooster**: The piezo-electric effect of diamond. The effect has been investigated by a delicate method using magnetic attraction to apply pressure to the diamond. The result shows that the effect, if it exists, is less than $\frac{1}{200}$ of the effect observed in quartz cut perpendicular to the electric axis.

CAMBRIDGE.

Philosophical Society, Oct. 29.—**P. A. M. Dirac**: The basis of statistical quantum mechanics. Neumann's method of describing a Gibbs' ensemble of systems in quantum mechanics by a matrix is very closely analogous to the classical description. The matrix may be regarded as a function of the co-ordinates and momenta and is then the analogue of the classical density of distribution of representative points in phase space. An equation of motion for the quantum density is obtained, of the same form as the classical one, and a justification is provided for the usual assumptions of *a priori* probability in quantum theory.—**L. H. Gray**: The absorption of penetrating radiation. When an electroscope is shielded from all local radiations, and its natural activity has been allowed for, there remains a small residual ionisation which increases with altitude. One hypothesis attributes this ionisation to ultra-gamma radiation. Assuming a homogeneous isotropic radiation at the top of the earth's atmosphere, an approximate calculation is made of the ionisation to be expected at different heights and the relative contributions to the ionisation of the radiation of longer wave-length produced by the Compton scattering process from the primary radiation. As the altitude increases, the apparent absorption coefficient at first increases and then decreases.—**N. A. de Bruyne**: Note on the effect of temperature on the auto-electronic discharge. The auto emission is independent of temperature up to approximately 2000° and the apparently contradictory experimental results of Millikan are explained.—**J. Hargreaves**: The dispersion electrons of lithium. An attempt is made to estimate the number of electrons of dispersion (+) for the lines of the principal series of lithium, and the value of df/dv for the continuous spectrum, using a 'self-consistent' field, and Hartree's method of integration. Owing to polarisation effects the 'self-consistent' field does not, however, give the correct term-values. General normalised solutions of the wave-equation with continuous *eigenwerte* are given, and the normalised solution for the zero *eigenwert* is deduced by a limiting process.—**E. E. Watson**: Current measurement with a Compton quadrant electrometer. By using the rate of deflection method with a Compton quadrant electrometer, a current of 10^{-14} amp. can be measured in a minute. The rate of deflection of the electrometer spot is proportional to the current right up to the fastest measurable speed, 5 cm. per sec.

PARIS.

Academy of Sciences, Oct. 8.—**Ch. Depéret and J. Viret**: The discovery of the fauna of Burdigalian mammals of the Orléanais sands in Haut-Armagnac. Excavations near the village of La Romieu have given the more or less complete debris of 16 species of mammals, a list of which is given.—**Georges Claude**: The extraction of krypton and xenon from air and from gases dissolved in water. The aim of the work described was to obtain xenon and krypton, not from air specially treated for the purpose, but as a by-product from a commercial process. Special rectifying apparatus designed to prevent mechanical losses of krypton and xenon has given a continuous stream of gas containing 0·1 per cent of xenon, and krypton at about one-half of the amount present in the air treated. Removal of oxygen by combustion in hydrogen raised the proportion of the two rare gases to 2 per cent. This mixture is further concentrated by means of silica cooled in liquid oxygen. About 10 litres of krypton and 800 c.c. of xenon per day can be thus prepared.—**Léon Guillet and Ballay**: The influence of the composition and cold hardening on corrosion and the increase of the size of the grain in aluminium. The influence of cold hardening is more marked in 98·81 per cent aluminium than with pure aluminium (99·87 per cent).—**Maurice Fréchet**: The existence of an index of desirability of indirect benefits.—**Bertrand Gambier**: Remarkable configurations of four right tangents to certain curves.—**Georges Bouligand**: The order of measurement of a closed ensemble.—**A. Buhl**: The function $E(y)$ of Mittag-Leffler and developments in series intervening in mathematical physics.—**P. Myrberg**: Discontinuous groups of biuniform transformations.—**J. Guéron**: The electro-chemical study of the action of acids on the solutions of some salts of zinc.—**Mme. and M. M. Lemarchands**: The quantitative separation of barium and calcium. The increase of solubility caused by the presence of hydrochloric acid is emphasised.—**V. Auger and Al. Yakimach**: The phosphates and arsenates of quadrivalent manganese. The preparation and properties of some crystallised compounds of tetravalent manganese are described, including $((NH_4)H \cdot PO_4)_2\,MnO$, $Mn(H_2AsO_4)_4$, and $((NH_4)HAsO_4)_2MnO$. All these compounds contain active oxygen, and with hydrogen peroxide in acid solution evolve oxygen.—**Lespieau**: 1·12-Dodecanediol. Pentamethylene bromide, reacting with magnesium, gives not only the normal $(CH_2)_5(MgBr)_2$, but also a series of condensation products of the general formula $(CH_2)_{5n}(MgBr)_2$. The glycol $CH_2(OH) \cdot (CH_2)_{10} \cdot CH_2OH$ has been prepared from one of the latter products.—**Mlle. L. Remy**: Mutation in mosaic.—**M. Bridel and Mlle. S. Grillon**: The glucoside from *Gaultheria procumbens*, giving rise to methyl salicylate, is monotropitoside. The identity of this glucoside with monotropitoside from *Monotropa Hypopitys*, *Betula lenta* and other species is definitely proved.—**Mlle. M. L. Verrier**: The peculiarities of the mitochondrial apparatus of some cecidia.—**Moto Sakurai**: The tracheal gland of some insects.—**Mme N. Dobrovolskaïa-Zavadskaïa**: A strain of mice presenting an unusual mutability of the tail.—**Et. Burnet**: Biochemical modifications impressed on cultures of *B. abortus* with the view of using it in giving immunity against Maltese fever.

VIENNA.

Academy of Sciences, July 5.—**E. Hartmann** and **J. Zellner**: The chemistry of the higher fungi. (19) *Polyporus pinicola*. An ally of the larch fungus containing a dozen different compounds.—**N. Fröschl** and **J. Zellner**: The chemistry of the higher fungi. (20) *Omphalia Campanella, Marasmius Scorodonius, Boletus cavipes, Calocera viscosa*.—**J. Zellner**: Contributions to the comparative chemistry of plants. (21) Chemistry of plants with latex.—**J. Pollak** and **F. v. Meissner**: The constitution of the disulpho-acids of meta-xylol.—**J. Pollak** and **E. Riess**: Oxy-thiophenols.—**E. Riess**: The oxidation products of 4, 4-dichlor-2, 2-dinitro-diphenyl-sulphide and disulphide.—**K. Brunner**: Determination of the constitution of β-resorci-dicarboxylic acid.—**A. Kohaut**: Thermo-electric forces in wires partially covered with another metal.—**F. Bartl**: The compressibility of liquids. A formula is proposed which seems to connect the molecular weight, the density and the number of atoms in the molecule with the compressibility; also a table showing observed and calculated results for 25 different liquids, including mercury, ether, alcohol, and water.—**F. Raaz**: The electric conductivity of lithium silicates in the solid state. In contrast to other silicates, the lithium silicates show a marked conductivity at higher temperatures, and the orthosilicate a greater conductivity than the metasilicate.

Official Publications Received.

BRITISH.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1151 (Ae. 317): The Characteristics of a Karman Vortex Street in a Channel of Finite Breadth. By H. Glauert. (T. 2573.) Pp. 14+1 plate. (London: H.M. Stationery Office.) 9*d*. net.

The Calendar of the Pharmaceutical Society of Great Britain 1928–1929. Pp. 242. (London.) 3*s*. 6*d*.

Madras Fisheries Department. Administration Report for the Year 1926–27. By Dr. B. Sundara Raj. (Report No. 1 of 1928, Madras Fisheries Bulletin, Vol. 22.) Pp. iii+99+3 plates. (Madras: Government Press.) 1 rupee.

New Zealand. Department of Lands and Survey: Scenery-Preservation. Report for the Year ended 31st March 1928, together with Statement of Accounts and Schedule of Lands acquired and reserved during the Year under the Scenery Preservation Act. Pp. 12+3 plates. (Wellington, N.Z.: W. A. G. Skinner.) 9*d*.

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum. Vol. 4, No. 1. Pp. 144. (Adelaide.) 10*s*. 6*d*.

Government of the Gold Coast. Report on the Survey Department for the Period April 1927–March 1928. Pp. 31+8 plates. (Accra: Colonial Secretariat; London: The Crown Agents for the Colonies.) 3*s*.

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Fourteenth and Fifteenth Years) 1926 and 1927. Supplement 2. Pp. 171+29 plates. (East Malling: East Malling Research Station.) 5*s*. 6*d*.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 8: Methods for the Examination of Soils. By Prof. J. A. Prescott and C. S. Piper. Pp. 52. Bulletin No. 36: Kimberley Horse Disease (Walk-about Disease). By D. Murnane and Prof. A. J. Ewart. Pp. 61. (Melbourne: H. J. Green.)

The Royal Aeronautical Society, with which is incorporated the Institution of Aeronautical Engineers. List of Members. Pp. 55. (London.)

British Cast Iron Research Association. Seventh Annual Report for the Year ending June 30th, 1928. Pp. 24. (Birmingham.)

Empire Grown Sisal and its Importance to the Cordage Manufacturer: Memorandum prepared by the Imperial Institute with the co-operation of its Advisory Committee on Vegetable Fibres, and issued by the Empire Marketing Board. (E.M.B. 10.) Pp. 25. (London: H.M. Stationery Office.) 6*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 11: The Action of Aromatic Amines on Nitric Esters. By Dr. Hugh Ryan and Michael T. Casey. Pp. 101-111. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

FOREIGN.

Det Kongelige Departement for Handel, Sjøfart, Industri, Handverk og Fiskeri: Norges Svalbard- og Ishavs-Undersøkelser. Skrifter om Svalbard og Ishavet. Nr. 13: The Micromycetes of Svalbard. By J. Lind. Pp. 61+3 plates. 6.00 kr. Nr. 15: Geology of Bear Island, with special reference to the Coal Deposits, and with an Account of the History of the Island. By Gunnar Horn and Anders K. Orvin. Pp. xi+152+10 plates. 15.00 kr. Nr. 16: Déterminations astronomiques pour Norges Geografiske Opmaling. Par Hans S. Jelstrup. Pp. 28. 2.00 kr. Nr. 17: Beiträge zur Kenntnis der Kohle von Svalbard (Spitzbergen und der Bäreninsel). Von Gunnar Horn. Pp. 60+5 Tafeln. 5.50 kr. (Oslo: Jacob Dybwad.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 80. Agalinea and Allies in North America, I. By Francis W. Pennell. Pp. 339-449. (Philadelphia, Pa.)

Hamburger Sternwarte in Bergedorf. Index der Sternörter 1900–1925. Herausgegeben von R. Schorr und W. Kruse. Band 1: Der nördliche Sternhimmel. Pp. ii+808. Band 2: Der südliche Sternhimmel. Pp. ii+291. (Bergedorf.)

Hamburger Sternwarte in Bergedorf. Erstes Bergedorfer Sternverzeichnis 1925·0 enthaltend die mittleren Örter von 4988 Sternen nach Beobachtungen am Repsoldschen 19 cm.-Meridiankreis in den Jahren 1918 bis 1926. Von Dr. Franz Dolberg. Pp. xxviii+108+2 Tafeln. (Bergedorf.)

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol. 6, No. 1. Pp. iv+69+37. Japanese Journal of Geology and Geography: Transactions and Abstracts. Vol. 6, Nos. 1-2. Pp. ii+62+7+12 plates. (Tokyo: National Research Council of Japan.)

Argeologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Eerste Stuk: Die Koningse Kultuur. 1: Die Koningse Industrie. Deur Dr. Ir. E. C. N. van Hoepen. Pp. 11+4 plates. (Bloemfontein.)

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 4, October. Pp. 487-684. 25 cents. Research Paper No. 18: Mutual Inductance of any Two Circles. By Chester Snow. Pp. 531-542. 5 cents. Research Paper No. 22: The International Temperature Scale. By George K. Burgess. Pp. 635-640. 5 cents. Research Paper No. 23: Tables of Theoretical Zeeman Effects. By C. C. Kiess and W. F. Meggers. Pp. 641-684. 15 cents. (Washington, D.C.: Government Printing Office.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 7, Part 3: Paleobotany of Porto Rico. By Arthur Hollick. Pp. ii+177-393+plates 51-68. (New York City.)

Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 1, No. 5, November. Pp. 685-866. (Washington, D.C.: Government Printing Office.) 25 cents.

Diary of Societies.

FRIDAY, NOVEMBER 30.

TEXTILE INSTITUTE (Manchester), at 1.15.—E. E. Canney: Rational Development in the Organisation of the Cotton Industry.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section) (Newcastle-upon-Tyne), at 2.30.—J. H. M. Cragg: Notes on an Electric Heading Machine.—*Papers open for discussion*:—Bore-holes and their Purposes, W. S. Armstrong; Diamond Boring applied to Tapping Drowned Areas Underground, F. E. Smyth.

ROYAL SOCIETY (Anniversary Meeting), at 4.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. W. E. Dalby: The Possible Vibration of a Ship's Hull under the Action of an Unbalanced Engine (Thomas Lowe Gray Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Dr. E. V. Telfer: Frictional Resistance and Ship Resistance Similarity.

INSTITUTE OF TRANSPORT (Manchester, Liverpool, and District Section) (at Manchester), at 6.30.—J. F. Leeming: Civil Air Transport.

ROYAL SANITARY INSTITUTE (at Town Hall, Manchester), at 7.—Dr. G. S. Coleman: The Training of a Sanitary Inspector.—F. W. Platt: Some Aspects of the Housing Problem.

ENGINEERING AND SCIENTIFIC CLUB (Wolverhampton), at 7.—Prof. D. Smith: Cutting Tools, their Treatment and Performance.

TEXTILE INSTITUTE (jointly with Leigh Municipal College Textile Section) (at Leigh), at 7.15.—W. Bailey: Various Methods of Winding Artificial Silk Yarns.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—C. W. Harvey: The Manufacture of Decorative Metal Work.

INSTITUTION OF PRODUCTION ENGINEERS (at 83 Pall Mall), at 7.30.—Dr. G. H. Miles: Psychology as an Aid to Production.

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Graduates' Branch) (at 51 West Regent Street, Glasgow), at 8.—W. P. Kirkwood: Brakes.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—W. Lind-Jackson: Napier Aero Engines.

SATURDAY, DECEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. W. C. Whittaker: The Violin Sonatas of William Young (17th Century).

MONDAY, DECEMBER 3.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Sir James MacKenna: The Sugar Industry of India.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. T. A. Stephenson: Contribution to Actinian Morphology: the Genera *Phellia* and *Sagartia*.—Miss S. M. Manton: On Some Points in the Anatomy and Habits of the Lophogastrid Crustacea.—Prof. H. Graham Cannon and Miss S. M. Manton: On the Feeding Mechanism of the Syncarid Crustacea.—B. P. Wiesner and Prof. F. A. E. Crew: The Preparation of ρ Factors: their Physiological Action upon the Immature, Mature, and Senile Gonad.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Dr J. A. Fleming: Matter, Energy, Radiation, Life, and Mind.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at University, Birmingham), at 7.—F. H. Rosencrants: Practice and Progress in Combustion of Coal as applied to Steam Generation.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Leeds), at 7.15.—Dr. H. W. Davies and Prof. B. A. McSwiney: Poisoning and Disease in Industry. (1) Carbon Monoxide Poisoning.

HUNTERIAN SOCIETY OF LONDON, at 7.30.—C. S. Lane-Roberts and A. McAlister: Discussion on The Artificial Termination of Pregnancy.

EUGENICS SOCIETY (at Linnean Society), at 8.—Dr. H. Campbell, Dr. Ryle, and others: Discussion on Public Health and the C3's.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Capt. B. S. Thomas: The South-East Borderland of the Rub 'Al Khali.

SOCIETY OF CHEMICAL INDUSTRY (London Section).—Dr. L. A. Jordan: Scientific Aspects of Paint Technology.

TUESDAY, December 4.

Royal Institution of Great Britain, at 5.15.—Sir William Bragg: Diamonds (III.).
Institution of Civil Engineers, at 6.—H. V. C. Johnstone: The Gezira Irrigation Scheme: Canalisation of the Gezira.—J. R. Russell: Sluices and Machinery of the Gezira Irrigation Scheme: Blue Nile Dam and Canalisation.
Institution of Electrical Engineers (East Midland Sub-Centre) (at Technical College, Leicester), at 6.45.—H. Cotton: Polyphase Commutator Motors and their Application.
Royal Photographic Society of Great Britain, at 7.—A. Basil: Portraiture.
Institution of Engineers and Shipbuilders in Scotland (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. H. E. Merritt: Gear Transmission.
Institute of Metals (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—A. G. Lobley: Electric Furnaces.
North-East Coast Institution of Engineers and Shipbuilders (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.
Quekett Microscopical Club, at 7.30.
Television Society (at Engineers' Club), at 8.—Prof. Cheshire: Tuning Forks; how they talk and what they have to say. Lecture preceded by a demonstration of Television by Wireless.
Royal Society of Medicine (Orthopædics Section), at 8.30.—G. Perkins and others: Discussion on The Painful Shoulder.

WEDNESDAY, December 5.

Alchemists' Society (in Chemical Lecture Theatre, Glasgow University), at 3.30.—Debate.
Geological Society of London, at 5.30.
Institution of Electrical Engineers (Wireless Section), at 6.—R. H. Barfield and G. H. Munro: Attenuation of Wireless Waves over Towns (Effect of Towns, including Buildings, Tuned Aerials, etc., on Wave Damping).
Women's Engineering Society (at 138 Piccadilly), at 6.15.—P. E. Rycroft: Modern Steam Plants.
Institution of Civil Engineers (Students' Meeting), at 6.30.—J. W. F. Gardner: The Renewal and Strengthening of Railway Bridges.
Institution of Heating and Ventilating Engineers (at Caxton Hall, Westminster), at 7.—S. Hopkins: Constant Pressure Thermal Storage.
Institute of Metals (Swansea Local Section) (at Thomas' Café, Swansea), at 7.—R. M. Doidge: Refractories.
North-East Coast Institution of Engineers and Shipbuilders (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—H. A. Morham: Feed Water Heaters.
Institution of Automobile Engineers (Derby Graduates' Branch) (jointly with Derby Society of Engineers) (at Technical College, Derby), at 7.30.—J. H. Dickenson: The Heat Treatment and Mechanical Properties of Alloy Steels.
Leicester Literary and Philosophical Society (Chemistry Section) (at Museum, Leicester), at 8.—S. B. Bratley: Dairy Chemistry.
Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8.—A. Scott Dodd: The Natural Occurrence of Boric Acid in Fruits.—J. Evans and A. O. Jones: Chemical Tests for Drunkenness.—C. A. Adams and J. R. Nicholls: The Analysis of Mixtures containing Acetone Ethyl Alcohol and Iso-propyl Alcohol.—J. R. Nicholls: The Specific Gravities and Immersion Refractometer Readings of Dilute Mixtures of Acetone and Water.—J. J. A. Wijs: The Wijs Method as the Standard for Iodine Absorption.
Royal Society of Arts, at 8.—Sir Eustace Tennyson d'Eyncourt: Fuel for Ships.
Institution of Mechanical Engineers (Liverpool Branch) (jointly with Liverpool Engineering Society).—W. A. Benton: Weighing Machinery.
Institution of Mechanical Engineers (Yorkshire Branch) (at Sheffield).—Prof. F. C. Lea: Chairman's Address.
Royal Microscopical Society (Biological Section).

THURSDAY, December 6.

Royal Society, at 4.30.—Prof. A. E. Boycott, C. Diver, S. Hardy, and F. M. Turner: The Inheritance of Sinistrality in *Limnæa peregra*.—R. H. Burne: A System of "Fine" Vessels associated with the Lymphatics in the Cod (*Gadus Morrhua*).—E. Hindle: Further Observations on Chinese Kala-Azar.—*Papers to be read in title only*:—E. Ponder: Hæmolysis by Brilliant Green and Serum.—Prof. A. V. Hill, Grace Eggleton, and P. Eggleton: The Coefficient of the Diffusion of Lactic Acid through Muscle.—C. H. Best: K. Furusawa and J. H. Ridout: The Respiratory Quotient of the Excess Metabolism of Exercise.—Prof. A. V. Hill and W. Hartree: The Energy liberated by an Isolated Muscle during the Performance of Work.—Prof. A. V. Hill: The Diffusion of Oxygen and Lactic Acid through Tissues. Parts I., II., III., and IV.—Dr. D. Keilin: Cytochrome and Respiratory Enzymes.—F. R. Miller and N. B. Laughton: Myograms yielded by Faradic Stimulation of the Cerebellar Nuclei.—D. Burk: The Free Energy of Glycogen-Lactic Acid Breakdown in Muscle.—F. C. Smith: The Ultra-Violet Absorption Spectra of Certain Aromatic Amino-Acids and of the Serum Proteins.
Imperial College Chemical Society, at 5.—Dr. E. K. Rideal: Chemical Activation.
Royal Institution of Great Britain, at 5.15.—Sir Richard Paget, Bart.: Human Speech as a Method of Expression by Gesture (I.).
Institution of Electrical Engineers, at 6.—A. E. Foster, P. G. Ledger, and Dr. A. Rosen: The Continuously Loaded Submarine Telegraph Cable.
Society of Chemical Industry (Bristol Section) (jointly with Fuel Section) (at University, Bristol), at 7.30.—Dr. E. W. Smith and H. M. Spiers: Refractories in Industry.
Chemical Society, at 8.—U. R. Evans: The Mechanism of Corrosion.—E. H. Farmer and W. D. Scott: Properties of Conjugated Compounds. Part VI. The Dibromination Products of Cyclic Butadienes.—E. V. Bell and G. M. Bennett: The Stereoisomerism of Disulphoxides and Related Substances. Part IV. Di- and Tri-sulphoxides of Trimethylene-trisulphide.—G. M. Bennett and G. H. Willis: The Structure of Organic Molecular Compounds.
Royal Society of Medicine (Tropical Diseases Section), at 8.15.—Dr. H. H. Scott and Dr. H. B. Day: Clinical and Pathological Correlation in Typhoid and Allied Diseases.
Institution of Mechanical Engineers (Leeds Branch).
Institution of Mechanical Engineers (Glasgow Branch) (jointly with Institute of British Foundrymen—Scottish Branch) (at Glasgow).—Discussion on Steel Castings.

FRIDAY, December 7.

Royal Society of Medicine (Otology Section), at 10.30 A.M.—G. F. Jenkins, T. B. Layton, and E. D. Davis: Discussion on Meningitis.
Institution of Water Engineers (at Geological Society), at 10.30 A.M.—J. Bowman: The Consumption and Waste of Water.—E. J. Rimmer: Legal Considerations relating to the Administration of Engineering Contracts.—A. W. Burtt: The Sandfields.—W. T. Halcrow, G. B. Brook, and R. Preston: The Corrosive Attack of Moorland Water on Concrete.
Royal Astronomical Society, at 4.30.—Geophysical Discussion on Atmospheric Ionisation. Chairman, Dr. G. C. Simpson. Discussion to be opened by Prof. J. Nolan, and continued by Dr. J. S. Owens, Prof. A. M. Tyndall, and R. E. Watson.
Institution of Engineering Inspection (at Royal Society of Arts), at 5.30.—C. H. Faris: The Application of Electro-deposited Metals to Engineering.
Philological Society (at University College), at 5.30.—Prof. F. W. Thomas: Weak R in Central Asia.
British Psychological Society (Æsthetics Section) (at Bedford College for Women), at 5.30.—J. Littlejohns: The Appreciation of Pictures.
Society of Chemical Industry (Liverpool Section) (at Liverpool University), at 6.—Prof. H. E. Armstrong: Hurter Memorial Lecture.
North-East Coast Institution of Engineers and Shipbuilders (at Mining Institute, Newcastle-upon-Tyne), at 6.30.—K. O. Keller: Combustion and its Difficulties in Marine Oil Engines.
Institution of Mechanical Engineers (Informal Meeting), at 7.
Royal Photographic Society of Great Britain (Pictorial Group—Informal Meeting), at 7.—H. Bairstow: Bromoil Transfer.
Junior Institution of Engineers, at 7.30.—Lt.-Col. J. T. C. Moore-Brabazon: The Future of Coal in relation to Industry (Presidential Address).
Geologists' Association (at University College), at 7.30.
Society of Chemical Industry (Manchester Section) (jointly with Institution of the Rubber Industry—Manchester Section) (at Geographical Hall, Manchester).—Dr. Auer: Colloid-Chemical Changes in Rubber and other Unsaturated Organic Compounds.
Society of Chemical Industry (South Wales Section) (at Thomas' Café, Swansea).—Prof. C. James: Pollution of Rivers.
Oxford University Junior Scientific Club.—Sir E. Farquhar Buzzard: The Harvey Tercentenary Film.

SATURDAY, December 8.

Royal Institution of Great Britain, at 3.—W. Bayes: The Gulf between Painter and Public (I.).
Mining Institute of Scotland (at Glasgow).

PUBLIC LECTURES.

SATURDAY, December 1.

Horniman Museum (Forest Hill), at 3.30.—M. A. Phillips: Bird Life.

MONDAY, December 3.

University College, at 5.15.—Prof. W. E. Gibbs: Chemical Engineering Education and Research in Great Britain.
East Anglian Institute of Agriculture (Chelmsford), at 7.—J. Garton: Can Canadian Methods of Farming be adopted in this Country with Advantage?

TUESDAY, December 4.

Royal Sanitary Institute, at 6.30.—H. C. Adams: The Drainage of Basements and Low-Lying Areas and the Prevention of Damp (Chadwick Lecture).

WEDNESDAY, December 5.

Royal Institute of Public Health, at 4.—Dr. R. Fortescue Fox: Rheumatism in relation to Industry.
King's College, at 5.30.—Prof. R. R. Gates: The Indebtedness of Industry to Pure Science: The Relation of Botany to the Grain, Rubber, and Cotton Industries.
University College, at 5.30.—Prof. A. E. Richardson: The Housing of Books.

FRIDAY, December 7.

King's College, at 5.30.—Sidney Smith: Babylonian Amulets.

SATURDAY, December 8.

Horniman Museum (Forest Hill), at 3.30.—R. Aitken: Life and Traditions in the Spanish Rioja.

CONFERENCE ON DRYING.

Thursday and Friday, December 6 and 7.

Institution of Chemical Engineers (at Chemical Society).
Thursday, Dec. 6, at 10.30.—S. T. C. Stillwell: The Seasoning or Drying of Timber.—A. T. Henly: Tunnel and Stove Drying.
At 2.30.—J. A. Reavell: Film and Spray Drying.—Prof. J. W. Hinchley: Drying by Pressure.
Friday, Dec. 7, at 10.30.—T. J. Morgan: Rotary Dryers.—G. W. Riley: Vacuum Drying.
At 2.30.—Dr. S. G. Barker: The Hygroscopic Nature of Textile Fibres.—B. J. Owen: The Drying of Agricultural Products.—A. C. Barnes: Some Drying Problems in Tropical Africa.

SATURDAY, DECEMBER 8, 1928.

CONTENTS.

Woodlands of Great Britain.

THE report on the "Census of Woodlands and Census of Production of Home-grown Timber, 1924," recently issued by the Forestry Commission,[1] is an interesting production, since it records, probably for the first time, the approximate areas, nature, and conditions of the woods of Great Britain. In England and Wales most of the data were collected by public-spirited private individuals, selected for their knowledge of particular districts. In Scotland the work was done by the Forestry Commissioners' "regular local correspondents" (the term appears obscure), and by the technical staff. The six-inch Ordnance map was used, and the acreage of all woods exceeding 2 acres in extent was marked on the maps. These maps were then sent to the individual proprietors concerned, who were asked to indicate on the map the type and age-classes of their woods. The census was commenced in the autumn of 1921, but was not completed until the end of 1926. The year 1924 has been adopted as the date of the census, as most of the work was carried out in that year, and adjustments have been made from the statistics collected in other years.

Whilst this census cannot be compared for accuracy with those made by a highly trained and skilled staff, as, for example, the census recently undertaken for the forests of Sweden, it has for present purposes a very distinct value, since it enables us to know, if only roughly and approximately, the types of the various woods in existence in Great Britain, and the probable amount of material of various classes they contain.

For the purposes of classification, the woods were divided into two main groups, 'Economic' and 'Uneconomic,' with a third group under which optional information might be furnished on the subject of the degree of stocking of the individual woods. Economic woods are defined as areas maintained primarily for timber production; uneconomic woods are "those areas which are not maintained for timber production, but primarily serve some other purpose." These were most unfortunate definitions to adopt, as it at once ensured the classification as 'uneconomic' of every acre of woodland which the assessor could not regard as a commercial proposition. Yet there are many woods in Great Britain which, although their purpose may have been primarily sport, shelter, or amenity, produce materials which

[1] Forestry Commission. Report on Census of Woodlands and Census of Production of Home-grown Timber, 1924. Pp. 68. (London: H.M. Stationery Office, 1928.) 1s. 9d. net.

are utilised by the local population and have been so used for centuries. At the present day and with changing conditions, it is dangerous to label any area of woodland as 'uneconomic.' Out of the 3,000,000 acres of woods in Great Britain there are probably very few to which the term would apply—for very often the value of a tract of woodland is not primarily connected with its timber-producing capacity—a fact fully accepted by the experienced professional forester. This subdivision influences to a marked degree the methods upon which the results of the census are tabulated. Under economic or potentially productive we have—conifers, 671,840 acres; mixed conifers and hardwoods, 301,690 acres; hardwoods, 443,340 acres; or a total of 1,416,870 acres. Given separately under the same group are coppice and coppice-with-standards, 528,670 acres; scrub (poor coppice areas and so forth), 330,700 acres; and felled and/or devastated, 478,100 acres. Under uneconomic, the amenity woods, shelter belts, etc., amount to 204,290 acres.

Nearly half the area of hardwoods consists of oak woods. It may be agreed that a considerable portion of this area is not under the best forest management, and that present-day fellings are making heavy inroads into the old growing stock. In the interests of the country, it is to be hoped that the major portion of this area will be maintained under oak and other suitable valuable hardwoods, and that they may not be replaced by the conifer. The census shows that the large area of 528,670 acres consists of coppice and coppice-with-standards. Much of this is in poor condition, but there appears to be little doubt that the introduction of a good system of management would result in a considerable proportion of this area becoming a paying proposition. Far more serious is the disclosure that no less an area than 808,800 acres consists of scrub and felled or devastated areas. This large area includes considerable tracts felled during the War. It would appear a somewhat grave reflection on the forest policy of Great Britain that a more energetic effort should not have been made to replant a larger portion. For, in the case of the felled areas, the valuable humus layer built up through the years the former crop stood on the ground is becoming dissipated and the soil thereby impoverished.

The census will have fulfilled a valuable object if it leads to a realisation of the fact that a true forest policy for Great Britain should include steps to safeguard and improve all the woodland areas and forest soils of the country.

Norman Lockyer's Work and Influence.

Life and Work of Sir Norman Lockyer. By T. Mary Lockyer and Winifred L. Lockyer, with the assistance of Prof. H. Dingle, and contributions by Dr. Charles E. St. John, Prof. Megh Nad Saha, Sir Napier Shaw, Prof. H. N. Russell, the Rev. J. Griffith, Sir Richard Gregory, and Prof. A. Fowler. Pp. xii + 474 + 17 plates. (London: Macmillan and Co., Ltd., 1928.) 18*s*. net.

THIS book is essentially for those who know and use NATURE and knowing it wish to understand the man who brought it into being—as a child of quite unusual vigour and distinction—giving to it, almost from its birth, the individuality and strength of character which have long made it everywhere the recognised organ of scientific opinion: the *Times* of science. The achievement was his great contribution to scientific advance, of far greater value, I venture to say, because of the effect it has had in promoting the appreciation of scientific endeavour, than his work as an inquirer—which was largely that of a seer, in advance of his time, needing interpretations that only later additions to knowledge were to make possible. Still, the spirit of discovery was at the root of his being: from it he derived his force and it gave to him his success. Wise men like Huxley, seeing this in him, became his willing slaves.

The establishment of NATURE, now fifty-nine years old, was a literary, not a scientific feat, yet one needing for its success a rare combination of qualities—not merely literary but also editorial ability, breadth and intensity of scientific outlook and social qualities of an unusual force and range. The journal was not a financial success until after thirty years. To have kept the enterprise alive, during so long a period, was an astounding exercise of determination, diplomacy and skill. Lockyer was never an easy man to get on with. At times impetuous, often intolerant, always impatient beyond measure and most assertive, from an early date he held scientific workers generally at his behest. His whole-hearted unselfish devotion to his enterprise, his high aims, the importance to us of its success, the difficulty of the work—were so clearly recognised that we all rallied to his standard. There was a feeling that the journal had to be. NATURE is a power to-day because of the sure foundations he laid: upon this his successor—long his assistant and most severely trained in his service—during the past nine years, has been able

to build broadly and judicially, to meet the needs of all schools of scientific activity and opinion, without fear or favour. NATURE has been lucky in her assistants—Keltie and Gregory. Is the succession secure? I tremble, in asking the question, by the way.

In this connexion, I may direct attention to the following passage in "The Earlier Life and Letters of Walter H. Page."

"Consider the making of a periodical: what is the difference between a fairly good one and a really great one? It is only the difference of personalities and ideas that go into them. This is so simple that it sounds silly to state it. But there is no secret about making a great magazine. You must have, of course, a good craftsman at the head of it, a man of editorial skill, of good judgement, of some courage and of character but these are all common qualities and with all these you will make but a fairly good magazine. The stuff to make a great periodical of is yet lacking and this stuff is a prodigality of ideas—such as no one man has or can have. Ideas must grow about it with the very luxuriance of nature, must come to it from every quarter. It must have enough waste material to make all the other periodicals better than they are now. This requires more than the acquaintance and goodwill and casual suggestions of fertile men; *it requires, to a degree, the identification of their personalities with it*" (my italics).

It is because Lockyer was pre-eminently successful in securing 'the identification of the personalities' of scientific workers and of advanced scientific opinion of the day with his journal, that he made NATURE what it is and that his successor is successful. Page necessarily feigned modesty in appraising the qualities needed in an editor and set these far too low. Editors must be peculiar people to succeed: far more than good craftsmen. NATURE has been a success, because Lockyer wove for it a magic carpet upon which scientific workers in all subjects could be attracted to sit: to preserve this in effective condition can never be an easy task.

The story of Lockyer's life and work is told in the book in a general biography covering 226 pages, written by Prof. H. Dingle, upon material compiled by Miss Lockyer and Lady Lockyer with remarkable completeness. Then follow chapters by various writers appreciative of the several sections of his scientific and special work. From the general biography, we learn everything material in his career—in fact, it is possible to trace almost his daily occupation. Although most explicit, in a measure, the account is rather lacking in feeling—it is the work of a writer who has not known his subject sufficiently closely and at the early critical period of his activity to paint a really intimate picture. It is, in fact, as are so many portraits—technically good yet not quite the man himself. At times, the story is a little exaggerated, if not misleading, at least to one who, like myself, lived through the period under notice and was a close follower of all that happened, even sometimes behind the scenes. Probably Lockyer is best summed up in some of the doggerel current in early days: such as—

There was a young astronomer called Lockyer,
Who each year grew cockier and cockier,
Till he thought he was owner of the solar corona,
Did this young astronomer Lockyer;

or the following amusing item in a programme of an entertainment on shipboard on one of the eclipse expeditions to India: "Mr. Lockyer will play upon his own trumpet: Wait until the clouds roll by!"

In early days, Lockyer was irrepressible, overflowing with energy and enthusiasm, at times displaying an overmastering tendency to fill the picture, often making the rashest assertions. The unco' guid dryasdusts were a little shocked by such conduct. Fortunately he had a large circle of friends able to discount his little foibles, who gave him their support. The element of a strong personal vanity was undoubtedly there, you saw it in him, yet behind all such display there was clearly nothing but generosity and the desire to make others share with him the intensity of his belief in the value of scientific purpose. He had no academic training; to his great advantage, I think, he was self-taught and unhampered by professional prejudice.

Norman Lockyer was born at Rugby on May 17, 1836. His grandfather practised as a surgeon-apothecary at Kensington and his father was intended for the same profession but apparently never qualified. He settled eventually at Rugby, where "he found opportunities for indulging his liking for scientific pursuits," founding, with the help of others, the Rugby Literary and Scientific Institution, of which he became secretary and treasurer. He frequently lectured, first on chemistry, then on electricity. He even experimented on telegraphy. To carry out his work for the Literary and Scientific Institution, he obtained a printing press. He also had a taste for astronomy. It is easy to see, therefore, whence his son Norman derived his proclivities and breadth of outlook.

At thirteen, Norman Lockyer went to live with his uncle, Mr. Norman, at Ashow in Warwickshire, and attended a school at Kenilworth, where he became proficient in Latin. When twenty years old, he spent about a year in Switzerland, studying French and German; at this time he became a proficient French speaker. In February 1858, he became a Civil Servant, securing a clerkship in the War Office, by competitive examination. He then married and settled at Wimbledon.

Through one of his friends there, George Pollock, a barrister, Lockyer came into touch with Thomas Cooke, the famous optical glass maker. In 1861 he purchased a 3¾ in. Cooke telescope and set it up in his garden. He began to write articles on astronomical subjects. No doubt, Cooke was impressed by his enthusiasm for he lent him a 6¼ in. object glass; this was put into a papier maché tube and mounted on a rough iron stand in the garden. With this instrument, he did all his work until he went to South Kensington in 1871. Having observed a transit of the satellite Titan across Saturn, he sent an account to the *London Review* of May 10, 1862. This brought him a letter from the editor, Little, asking for occasional notes and a monthly article on "The Face of the Sky." This was the beginning of his career as a pressman. He was also encouraged by a letter from Dawes, a well known astronomical observer of the day. The earliest astronomical work of permanent value he did was on Mars; this brought him into touch with leading astronomers.

In 1863, Lockyer became scientific editor to the *Reader*, a review of literature, science and art, started by his nieghbours J. M. Ludlow and Tom Hughes. The articles and summaries he contributed covered the whole range of science. At this period, his literary activity was very great and he also came forward as a popular lecturer. He left Wimbledon early in 1865 for West Hampstead, where an observatory was built for his 6¼ inch Cooke refractor. His first spectroscopic observations of the sun were made in this year. Apparently, in conversations with Balfour Stewart, in 1866, he formed the idea that the nature of the flames seen around the darkened sun at an eclipse could be determined with the spectroscope: he was unable with the instrument at his disposal to effect his object. Thinking that it was not sufficiently powerful, he made application for a government grant, which he obtained early in 1867. An instrument was ordered from Browning but was not ready until October 1868. On the morning of Oct. 20 he obtained the expected result and at once sent a communication to the Royal Society.

By the strangest coincidence, the French astronomer, Janssen, had observed, in India, the total eclipse of the sun on Oct. 18: impressed by the spectrum of bright lines afforded by the prominences, the idea then occurred to him which had long been in Lockyer's mind. The next day he was able to see the lines in full daylight. The two observers had independently witnessed the same phenomenon for the first time. It is remarkable that the two communications came before the French Academy of Sciences at the same meeting. The French government formally recognised that honours were divided, by striking a medal bearing on the one side the portraits of the two astronomers in profile.

Lockyer found himself lionised. Little wonder that he henceforth became wedded to the instrument which had served him so well: armed with it he plunged into the sun. He appears to have been led to become a laboratory worker by his desire to account for the strong yellow line in the spectrum of the chromosphere which was unobtainable from any element then known. Frankland, at this time, was engaged in studying the combustion of hydrogen under high pressure and had formed the opinion that the sun did not, as had been assumed, consist of ignited solid or liquid matter but that the photosphere, at least, consisted of gases or vapours only. He had naturally been greatly interested in the recent spectroscopic discoveries and I believe invited Lockyer to join him in studying the hydrogen spectrum very carefully. Alexander Pedler, who had been my junior fellow student, was detailed for the work, MacLeod doing some of the glass blowing. In three short papers they published together, they were able to throw much light upon the condition of hydrogen in the prominences but the yellow line was not unmasked. Lockyer, as all know, soon afterwards came to the daring conclusion that it was an indication of an unknown element, which he named helium—a name even more happily chosen than that which he gave to his journal. The forecast was verified by Ramsay's isolation of the gas twenty-six years later. I was in the chair at the Chemical Society, about to give my presidential address, when the discovery was announced, just after I had presented the Society's Faraday medal to Lord Rayleigh for his discovery of argon—a dramatic moment.

Frankland's name has been associated with the discovery. In the general biography (p. 42) the

statement is made that in 1872 Frankland, in a letter to Lockyer, pointed out that he was not then and never had been satisfied that the line was not due to hydrogen. Lady Lockyer has most kindly given me a copy of the letter and with her permission I reproduce it.

Sept. 9th. 1872

DEAR LOCKYER,

I am just reading Dr. Carpenter's address to the British Association and at p. 7 find the following :—" But when Frankland and Lockyer, seeing in the spectrum of the yellow (!) solar prominence a certain bright line not identifiable with that of any known terrestrial flame, attribute this to a hypothetical new substance which they propose to call Helium, it is obvious that their assumption rests on a far less secure foundation."

Surely Dr. Carpenter is wrong in coupling my name with yours in connection with Helium as I remember always protesting, in our conversations about the yellow line, against making this assumption, until we had exhausted every effort to get the line out of hydrogen. Will you kindly let me know whether any such statement in our joint names has ever appeared.

I should have been quite ready to share with you the responsibility that the sun's chromosphere contains incandescent hydrogen ; indeed I consider that the proofs of this which we have obtained are even more convincing than would be the " capture of a flask of it " and its conversion into water.

Dr. Carpenter's statement that our assertion is founded upon " a certain line " shows that he has not read our papers on the subject.

Believe me,
yours very truly,
E. FRANKLAND.

In a later letter, Frankland wrote :—" I have written to Carpenter about Helium and asked him to put it right." We are carried back a long way by Frankland's phrase—" I should have been quite ready to share with you the responsibility that the sun's chromosphere contains incandescent hydrogen," etc.

I confess, after reading the story of his early life, that it is a surprise to me to learn that Lockyer was so fully qualified both for his editorial and his scientific work, by heredity—astronomy was in his blood—and early training and occupation. When he came upon the scene as solar chemist, the idea prevailed among us that he was but a War Office clerk and amateur astronomer, in no way a trained worker. He flashed into view as a new star, clearly of irregular orbit. My first acquaintance with him was in 1870, soon after my return, early in the year, from Germany. He was then under Frankland's sober and sure guidance. He became an independent worker in 1873, when he acquired the laboratory at South Kensington which he gradually developed into the Solar Physics Laboratory. It was here that he started chasing the elements with a view to their downfall. He was entirely without training for the task. Everything, in turn, was sealed up in a hard glass tube, provided with a spark gap, attached to the Sprengel pump—and became duly dissociated. Unfortunately, hydrogen was the usual product. He was so innocent a chemist, so anxious to justify his hypothesis, that I and others had great difficulty in persuading him that hydrogen was unavoidable, not the product of *elementary* dissociation. He soon passed over to safer ground—to the systematic study of the solar spectrum, still with the vision of 'dissociation' ever before his eyes. Late in 1878, he came forward openly with the thesis that, under solar conditions, the elements were dissociated into simpler elements —stating his case at great length in a paper laid before the Royal Society in December of that year.

The biography is a little misleading upon this matter. We are told that the view was revolutionary and that he found himself at variance with the general trend of scientific thought. This is not an accurate presentation of the situation. The view was not a novel one—the possibility was never doubted : the objection taken was rather to Lockyer's 'slap-dash' way of proving his case. His interpretation of much of the spectroscopic evidence he advanced was thought to be unsatisfactory ; especially was this true of his attempt to establish the existence of lines common to several elements. To be plain, much of his work was not trusted ; exact workers like Dewar and Liveing and Huggins simply would not listen to him ; even his friends Frankland and Roscoe shook their heads.

I am able to speak with inner knowledge. Lockyer, who was very anxious to have his work made public, insisted on my acting as his interpreter and to this end secured from the *Times* a request that I would write an article upon the reception of his paper. To the best of my belief, the article, more than a column long, on p. 3 of the *Times* of Dec. 18, 1878, commencing " At a crowded meeting such as is seldom witnessed, etc.," came from my pen. The position was a very difficult and delicate one : how far I carried diplomacy will be evident from the following quotations—

" There can be no question that the facts brought forward are of the highest importance and value and that they will have much influence on the

further development of spectrum analysis . . . his arguments are of a character so totally different from that ordinarily dealt with by chemists that they will hesitate for the present to regard them as proof of the decomposition of the elements until either they are assured by competent physicists that they cannot be explained by any other equally simple and probable hypothesis or until what Mr. Lockyer has foreshadowed as taking place to such an extent in other worlds has been realised beyond question or cavil in our own laboratories. . . . Chemists are careful to teach that what are at present regarded as elements are not necessarily simple bodies but merely substances which they are unable to decompose or which they have no special reason to regard as compound bodies. The remarkable relations, both in atomic weight and properties, existing between many of the elements tend, indeed, to show that they are related in the manner Mr. Lockyer supposes. We sincerely hope that he will continue his researches in this direction and we trust that at no very distant time he may be able to bring forward evidence sufficiently clear to convince even the most sceptical."

We now know, as is made plain in the book, in several of the special articles, that Lockyer had glimpsed a radiant vision, though much of his argument must be regarded as unsound, as was contended by his critics: the time was not ripe for its interpretation but to-day we willingly admit that he was the gifted seer, far in advance of his age. Happily his own school has contributed largely to the consolidation of his reputation—Prof. Fowler, in particular.

From destruction, Lockyer passed to construction and evolved his meteoritic hypothesis. He next sought to connect up archæology with astronomy. Finally, he let his imagination play over the field of university education. All these phases of his activity are considered by competent writers.

The general picture is one of astounding activity and fertility of imagination: whatever his shortcomings as a worker, he stands before us now a man of great achievement: of great penetrative power, a devoted public servant, one to whom the scientific fraternity is indebted to an extent which probably few can realise. NATURE is the story of science in its making. Lockyer planned for it a great future. We can but show regard for his memory by assisting to carry on the work, in the spirit in which he always wrought, to advance natural knowledge, in the service not merely of industry but also in the far higher service of man's faith in the eternal verity of natural law—in the belief that scientific method is the method that will ultimately prevail.

HENRY E. ARMSTRONG.

The Home of the Gurkhas.

Nepal. By Perceval Landon. Vol. 1. Pp. xxiii + 358 + 8 plates. Vol. 2. Pp. viii + 363 + 7 plates. (London: Constable and Co., Ltd., 1928.) 63s. net.

THOSE who are familiar with the temples and palaces of China and Japan will be fascinated by the beautiful photographs of Nepalese buildings contained in Mr. Landon's book. In Nepal, Mongolian architecture reached its zenith. Not only was the Nepalese architect a master of his art, but he was also assisted by expert wood carvers and metal workers who beautified the doors, windows, and eaves of every building with bold and original designs. The photographs, unfortunately, can give no hint of the colour of the buildings. In the text we read of rose-tinted walls, black woodwork, and brilliantly painted eaves. The buildings themselves we can never see, for the frontiers of Nepal are closed to Europeans.

The reasons for this exclusion are religious and political. In the eyes of its inhabitants, Nepal is holy ground, which would be defiled by the foot of a foreigner. During the nineteenth century the rulers of Nepal watched the British trader pushing in from the coasts across the plains of India, and hard on his heels followed the soldier and administrator. The British came to trade, but stayed to govern. If the British trader was allowed to cross its frontiers, the independence of Nepal would not long survive. The British and Indian Governments approve of the closing of the Nepalese frontiers, and no European may enter the country, unless invited to do so. Our knowledge of the country must therefore be based on observations made by a very few individuals who visit the country as guests of the ruler. Mr. Perceval Landon was one of these; he went to Nepal in 1924.

The first volume of Mr. Landon's book is devoted to the history of Nepal. There are very few trustworthy records, as the Nepalese historian was more concerned with flattering individuals than with setting down the truth. Buddha was born in Nepal, and at the date of his birth the country was apparently part of some Indian kingdom. It is probable that for many centuries a succession of Indian potentates claimed it as part of their possessions, though the warring hill tribes who inhabited the country were, in fact, independent. When the Moslem conquerors swept across India they failed to penetrate into Nepal, but they drove into it many Hindus, who brought about a revival of the Hindu religion.

The Gurkhas, who are now the dominant race, ›re originally a small tribe, ruled by the King of ›rkha, a petty town from which they take their ›me. By cunning and violence they gradually ade themselves masters of the whole country, but eir conquest was not completed until 1769. Their xt exploit was a raid into Tibet, which in turn ovoked reprisals from China. The Chinese drove e Gurkhas out of Tibet, and pursued them through kkim into Nepal. Finally, peace was made when e Chinese were within a few miles of Katmander ; e Gurkhas accepting a nominal Chinese suzer- nty. The Gurkhas then attempted to extend eir kingdom towards the west, but were checked the Sikhs under Ranjit Singh. After a pause ey tried to expand towards the south, and this d to a clash with the East India Company. fter a British column had penetrated into epal, a treaty of peace was signed in 1816, and e foundations were laid for the firm friend- ip between the Gurkhas and British, which s now been maintained for more than a cen- ry.

Mr. Landon devotes a chapter to the fate of Nana hib, who was responsible for the massacre of ritish women and children at Cawnpore during the utiny. He escaped to Nepal, and for many years l trace of him was lost. His relatives declared he as dead. There is, however, some evidence to ow that in 1895 he was wandering in India, estitute and imbecile.

In the second volume of his book Mr. Landon eals with the present conditions. The King of epal takes no active part in the government. The untry is ruled by a Prime Minister, whose powers re unlimited, and who holds office for life. The resent Prime Minister, Maharajah Chandra Sham her, is the maker of modern Nepal. He favours e introduction of such Western ideas and inven- ons as are not likely to undermine the religion or overnment of the country. His foreign policy ay be summed up as "Nepal for the Gurkhas, and riendship with the British." It should be remem- ered that Nepal is an independent State. No olitical developments in India can affect the overnment of Nepal, except indirectly.

At present there is little trade between Nepal and he outside world. In the future, considerable uantities of timber may be exported from the , the malarial forest belt which borders on ndia. The mineral wealth of the country has not en explored. Nepal's chief export is the Gurkha oldier. During the War, more than 200,000 Gurkhas left their country for active service. Few nations contributed so large a proportion of their manhood.

The religion of Nepal is a compromise between Hinduism and Buddhism. As the ruling families are Hindus, the Hindu aspect is now the more em- phasised, and increasing importance is attached to caste.

Mr. Landon's book is packed with information about the country and the people, and yet a great deal remains to be told. The text is a little difficult to follow, because each page contains copious foot- notes, which cannot be ignored, as they contain some of the most important and interesting infor- mation. There are twenty-five appendices, of which the most valuable deal with Buddhism, the races of Nepal, the flora and fauna, and the more important books and articles about the country. Nepal has recently been surveyed by Indian sur- veyors lent by the Government of India ; and a skeleton map based on this survey is included in the first volume.

Mr. Landon died before the publication of his work. If he left any notes on Nepal which have not been included in it, it is to be hoped that they may be published, or at least be made available for geographers and others. Information about Nepal is rare and precious.

Midwifery in Great Britain.

The History of British Midwifery from 1650 to 1800 : the Fitz-Patrick Lectures for 1927, delivered before the Royal College of Physicians of London. By Prof. Herbert R. Spencer. Pp. xxiv + 185 + 9 plates. (London : John Bale, Sons and Daniels- son, Ltd., 1927.) 15*s.* net.

THIS volume, which is from the pen of an eminent London specialist, represents the first detailed account by an English writer of British obstetrics during the period 1650–1800. The book consists of four chapters, preceded by an introduction on the Chamberlen family, one member of which, prob- ably Peter the Elder, invented what the author rightly designates as "the most beneficent of surgical instruments," the midwifery forceps.

The first chapter, which forms the bulk of the work, contains an account of the twenty-two chief British writers on midwifery during the period under consideration. Commencing with William Harvey, Dr. Spencer shows that this great man deserved the title given him by Aveling of 'father of British midwifery,' by reason of the wide view, scientific spirit, and conservative practice which were introduced by him into this department of

medicine, and have since remained the characteristic features of British obstetrics. Of Harvey's twenty-one successors described in this book, special mention must be made of Edmund Chapman, the first who publicly made known the forceps used by the Chamberlens in "An Essay for the Improvement of Midwifery" (1733); William Smellie (1697–1763), described by Fasbender as "one of the most important obstetricians of all times and all countries"; William Hunter, the author of a magnificent work on the gravid uterus; John Burton (1710–1771), who as author of the "Monasticon Eboracense" was better known as an antiquarian than as an obstetrician, though he served as the original of Sterne's Dr. Slop; John Leake (1729–1792), the founder of the Westminster Lying-in Hospital, and author of important works on puerperal fever, convulsions, and hæmorrhage; and Thomas Denman (1733–1815), the author of "The Introduction to the Practice of Midwifery," which is of value not only for the allusion to the work of his immediate predecessors and contemporaries, but also for the first account of induction of premature labour in cases of contracted pelvis, which, as Dr. Spencer points out, became a favourite operation in Great Britain long before it was accepted abroad.

In the second chapter, which is entitled "The Doctor and the Midwives," the author shows that before the forceps became generally known in 1733, the practice of midwifery in Great Britain was mainly in the hands of midwives, and the treatises on the subject were few in number and poor in quality. After the introduction of the forceps, midwifery was taken up by male practitioners, who thereby incurred the violent and scurrilous opposition of the midwives, which did not subside until the end of the eighteenth century.

The third chapter is devoted to an account of puerperal fever, with special reference to the work of Harvey, Gordon, White, and Denman. It is noteworthy, in view of later bacteriological discoveries, that the connexion of erysipelas with the disease, and the conveyance of infection by attendants, were observed by Gordon and Denman, and that Gordon prescribed washing of the attendants as a prophylactic measure. In the final chapter the contributions of British obstetricians during the seventeenth and eighteenth centuries are reviewed.

Dr. Spencer is to be warmly congratulated on his work, which shows a characteristic blend of fine scholarship and sympathetic estimation of his predecessors, with shrewd criticism and lively humour.

Our Bookshelf.

An Introduction to the Theory and Use of the Microscope. By Prof. C. R. Marshall and H. D. Griffith. Pp. viii + 90 + 3 plates. (London: George Routledge and Sons, Ltd., 1928.) 3*s*. 6*d*. net.

WHEN public interest in the curiosities of science was widespread, some fifty years ago, the possession of a microscope was a social necessity. The instrument to-day is no longer the popular plaything it formerly was. It has become a recognised part of the equipment essential to the progress of science and industry. Only the makers of microscopes will regret their useful restriction to the laboratory and the workshop, where the real function of the instrument can best be fulfilled.

According to the foreword, this rather brief "Introduction to the Theory and Use of the Microscope" has been prepared for the use of "students who require a microscope in their studies," and it is hoped by the authors that it will prove of value "as well to those amateur microscopists who wish to understand the principles upon which microscopy is based." In substance the book is founded on the lectures and practical work on microscopy forming part of the class work of medical physics in the University of Aberdeen.

Students who wish to obtain a working knowledge of this highly important instrument, and have no time for the study of a more elaborate treatise, will find this little book very useful. It provides a large amount of theoretical and practical information of the kind required by such readers in a small space, which might have been extended with advantage. In attempting in a few words to explain to beginners the principles of diffraction and resolution, the authors have assumed a difficult task. Abbe's diffraction theory can scarcely be discussed convincingly on the basis of 'scattering' and 'privileged directions.' Some of the statements made under the restriction of space may mislead the student rather than help him. "Outline pictures," for example, are described on the apparent assumption that rays caught by the lens reach the eye regardless of their obliquity.

At the end of the book there is included a useful chapter containing a selection of the more important fundamental formulæ and the principal physical proofs. There is an excellent index, which should enable the student to find at once the information he may desire.

J. W. F.

Naval Electrical Manual, 1928. Vol. 1. By Prof. Cecil L. Fortescue. Published by Authority of the Lords Commissioners of the Admiralty. Pp. xiii + 812 + xl. (London: H.M. Stationery Office, 1928.) 12*s*. 6*d*. net.

THE Lords Commissioners of the Admiralty have decided that a standard work on the theory of electricity is required for the information and guidance of officers and men of H.M. fleet. For this purpose, therefore, the "Naval Electrical Manual," Vol. 1, 1928, has been prepared by Prof. Fortescue. An examination of the book shows that it begins by giving electric and magnetic laws and formulæ

It then gives an introduction to direct current engineering. This is followed by a chapter entering very fully into the question of illumination. We next have alternating current engineering, including mercury rectifiers, and finally the practical theory of telegraphy and telephony.

Except in a few appendices, only elementary theorems of the calculus are used. Numerical examples are given at the ends of the chapters. The author writes very lucidly, and the theoretical matter given is not too difficult. His main object is to help the serious electrical student, and he has been successful. There is little to criticise anywhere in the book. The notation and nomenclature are practically always those adopted internationally. Where they differ from international usage there is good reason for the alteration. On p. 790 we do not see much use in having a special notation for the arithmetic mean of a harmonically varying quantity. With the possible exception of a few classical scholars, the readers of this work will have difficulty in understanding what the author means when he says that (H) eta is the English pronunciation of η, H, the seventh letter of the Greek alphabet. The book is cheap and should prove useful to many.

Optische Methoden der Chemie. Von Prof. Fritz Weigert. Pp. xvi + 632 + 16 Tafeln. (Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1927.) 38 gold marks.

PROF. WEIGERT'S book is a guide to the use of optical methods in the study of chemical problems. It is therefore a practical rather than a theoretical book, and may be regarded as a specialised form of the "Hand- und Hilfsbuch zur Ausführung physiko-chemischer Messungen" which was produced by Ostwald many years ago, and of which a recent edition was reviewed in these columns in 1926. The similarity of type of the two books may also be inferred from the fact that Prof. Weigert has dedicated his own volume to Prof. Luther, now joint author of the "Handund Hilfsbuch."

The scope of Prof. Weigert's book is indicated clearly by the headings of the chapters, which deal with optical instruments, light sources, light filters, photographic processes, spectroscopy, photometry, spectrophotometry, colorimetry and nephelometry, colour measurement, energy measurements, photochemical measurements, microscopy and ultramicroscopy, the measurement of refraction, the analysis of polarised light, and the study of phosphorescence and fluorescence and the like. These chapters provide full information as to the instruments and processes that are available for each type of measurement. The descriptions are illustrated by 300 figures in the text, and by 16 plates at the end of the volume. There is also an appendix, in which the wave-lengths and intensities of the principal spectral lines are given.

The book is obviously useful, and can be commended without hesitation to all laboratories in which optical methods of investigation are used; and it should clearly find a place on the shelf on which books of numerical data are kept for immediate reference in the laboratory. T. M. L.

The Thirsty Earth: a Study in Irrigation. By E. H. Carrier. Pp. 222 + 8 plates. (London: Christophers, 1928.) 10*s.* 6*d.* net.

THIS book gives a general account of irrigation suited to the reader who wishes to know something of its effects and of the way it is done without going into too much technical detail. The author begins with a statement of the changes in climate which make land formerly humid become more arid: this is largely based on Ellsworth Huntington's conclusions, though reference is given to the views of Stein and of Burrard; he then gives some account of the methods of irrigation in the ancient world and in the modern world. The remainder of the book, and by far the largest part, is taken up with a description of the irrigated areas in Europe, America, Australia, and Africa, both north and south.

The author has collected much useful information especially geographical, and he gives numerous references which are particularly helpful, as this branch of the literature of the subject is not too well known. There is one notable omission, which should be remedied if a second edition is called for: there is no discussion of the relation of irrigation to malaria. Whenever irrigation is started in a dry region there is always the danger of malaria, and indeed this has probably been a factor in the break up of old irrigation communities. Some reference should have been made to the excellent work of Sir Malcolm Watson and those associated with him in the Malay Peninsula, and to the investigations of Prof. K. B. Williamson on the suitability of certain waters for the development of the mosquito

Psychology of Infancy and Early Childhood. By Prof. Ada Hart Arlitt. (McGraw-Hill Euthenics Series.) Pp. xi + 228. (New York: McGraw-Hill Book Co. Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 10*s.* net.

THE recent formation of a Child Guidance Clinic under the Child Guidance Council, and with the approval of the London County Council, is an indication of the increasing importance attached to the mental care of the pre-school child in England. Miss Arlitt's book comes at a very opportune moment, and might with advantage be read by all parents who take a real interest in the mental welfare of their children. It is perhaps rather technical for the average reader, but there is a tremendous amount of straightforward material in the book which will point the way to train the pre-school child. If all mothers and fathers could be brought to carry out the training of the young children on the lines indicated, there would undoubtedly be a considerable lessening of the number of neurotics and psychoneurotics in England, and to a less extent a reduction in the number of cases of frank mental disorder of purely mental origin. The chapters on habit formation and on social attitudes in the pre-school period and the development of personality strike us as the two most useful chapters in a well-written and evenly balanced book.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Short Wave Echoes and the Aurora Borealis.

IN the issue of NATURE for Nov. 3 a short note by Prof. Carl Størmer appeared under this title. Prof. Størmer there described the observations made by him and Engineer Jørgen Hals, Oslo, of some remarkable echoes heard several seconds after the original signals—which were emitted from the short wave transmitter PCJJ (λ = 31·4 metre) Hilversum specially for the experiment—reached the receiver at Oslo. These special signals were first sent in March 1928. Since then the experiment has been repeated over and over again, sometimes twice and often four times a week. A continuous watch for these echoes was also kept at Eindhoven, Holland, in two different places, either by myself or an assistant, or by both of us. We did not hear any of these long period echoes for several months.

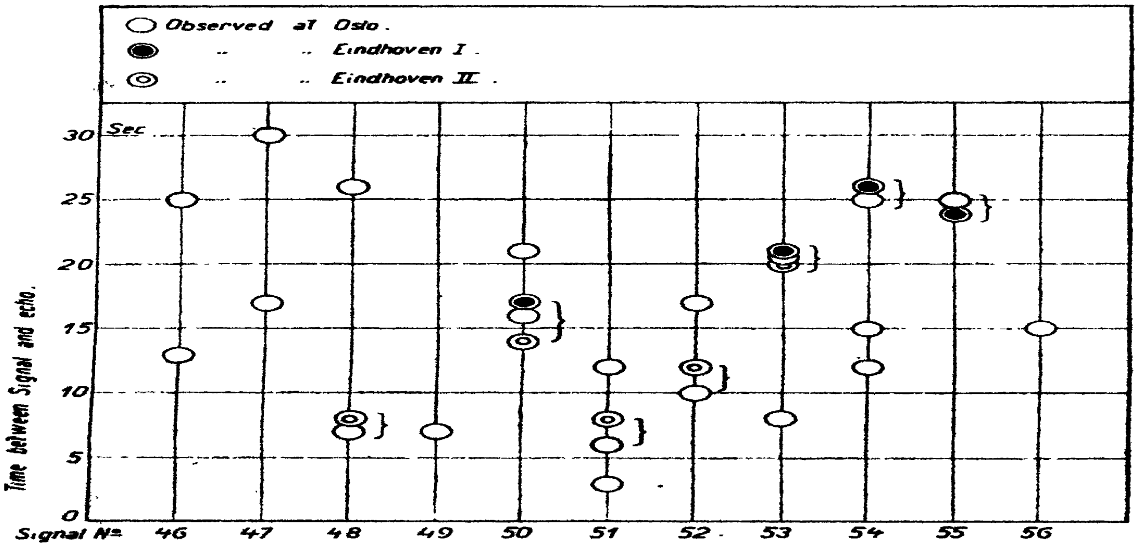

FIG. 1.

Then suddenly, on Oct. 11, I got a telegram from Prof. Størmer stating that very fine echoes had been heard that afternoon. Thereupon I immediately arranged the same night a series of test signals to be sent consisting of three short dots in rapid succession given every 30 seconds between 20 and 21 o'clock local time. I listened with my assistant to the 120 signals. Thirteen echoes were observed by both of us, the times between the signals and the echoes being: 8, 11, 15, 8, 13, 3, 8, 8, 8, 12, 15, 13, 8, 8 sec. The (radio) frequency of an echo was always exactly equal to the frequency of the signal, which fact could be easily verified as the signals were 'unmodulated,' and therefore the receiver was kept oscillating. The combination tone thus formed had exactly the same pitch, whether the original signal was received or the echo. The frequency of the local oscillator was slightly changed a few times after a signal was received, and then the echo came in causing a slightly varied pitch of the combination tone. When thereupon the receiver was left unaltered, the next real signal caused exactly the same pitch in the receiver as the last echo.

The echoes I heard were rather weak, and though their oscillation frequency could be easily identified to be the same as the frequency of the direct signals, the three dots of the original signal could not be recognised in the echo, the latter being of a blurred nature, except in the one case where the echo came in 3 seconds after the signal, when the three dots of the original signal were very plainly audible in the echo as well.

Thereupon I suggested to Prof. Størmer to count the signals in the further experiments, so that echoes heard in Oslo and in Eindhoven could perhaps be identified. Up to Oct. 24 neither in Oslo nor in Eindhoven were echoes heard. However, on that date, between 16 and 17 G.M.T., echoes were again observed both in Oslo and at two different places (3 km. apart) at Eindhoven. The frequencies of the two oscillating receivers at Eindhoven were adjusted at different sides of the carrier frequency of the signal in order to eliminate so far as possible the risk of regarding stray signals as echoes. Prof. Størmer kindly sent me the observations made that day at Oslo where 48 echoes were noted. Receiver No. 1 at Eindhoven (with two observers) noted 4 very weak echoes and receiver No. 2 at Eindhoven registered 5 echoes. A part of the simultaneous observations are plotted in the accompanying graph (Fig. 1). The timing of the ◉ observations was done with a stop watch, while for the observations ◎ the second hand of an ordinary watch was used. As the echoes often lasted more than 1·5 sec., there is no doubt that some echoes were heard practically simultaneously in the three places referred to above. Therefore, though they are often difficult to observe, there is no doubt that the echoes really exist, as they have been heard by several observers at different places and a few times even simultaneously.

As an explanation of these echoes, Prof. Størmer in his letter suggests that the waves are reflected from the streams and surfaces of electrons which he has postulated as the result of his researches on the aurora borealis. According to this view, the waves would have to penetrate the Kennelly-Heaviside layer and travel distances outside the earth's atmosphere comparable with the distance to the moon.

Now fortunately wireless waves, even short ones, usually do *not* penetrate the Kennelly-Heaviside layer, otherwise long-distance communication would be impossible, and an alternative explanation for the occurrence of these long interval echoes may be found in the fact that the waves may penetrate *well into but not through* the layer. Usually, as Prof. Appleton has shown, the layer has a relatively well-mark-

lower boundary against which waves travelling nearly vertically are sharply reflected. Now the apparent dielectric constant $\epsilon = 1 - \frac{4\pi^2 N e^2}{m\omega^2}$ (where N is the density of electrons) diminishes with N, and even becomes zero for waves of 31·4 metre length and a density of *circa* 10^6 electrons per c.c. Moreover, with the dispersion law expressed by ϵ we easily obtain for the phase and group velocity: $v_{\text{phase}} \times v_{\text{group}} = c^2$, so that at the places where the electron density is near the critical one, the phase velocity becomes infinite, *but at the same time the group velocity approaches zero.* When it now happens that the relative variation of the electron density with height over a distance of a wave-length is small, then the waves may penetrate and soak well into the Kennelly-Heaviside layer and travel in regions where the group velocity is small; they will thereupon be reflected at the region where ϵ approaches zero.

It is obvious that in these circumstances a considerable time may elapse before the echo is received, though the waves have never travelled outside the earth's atmosphere. This point of view would also explain the curious echoes observed by A. Hoyt Taylor and L. C. Young (*Proc. Inst. Radio Eng.*, 16. 561; 1928) which were distinct from the well-known round-the-world echoes (as was also remarked by Prof. Appleton at the last U.R.S.I. meeting). In fact, according to this explanation, any time-interval between signal and echo can be expected to occur, the phenomenon being wholly governed by the gradient of the electron density. This explanation fits in well with the fact that the time interval between signal and echo is extremely variable.

Our view is, therefore, that the group is compressed and 'bottled' for some time in those regions where the group velocity approaches zero.

BALTH. VAN DER POL.

Natuurkundig Laboratorium der
N. V. Philips' Gloeilampenfabrieken,
Eindhoven, Nov. 21.

IN connexion with Prof. Størmer's interesting letter on this subject in NATURE of Nov. 3, it may be of interest to inquire whether by purely terrestrial agencies such long temporal retardations of short wave signals may be explained. Abnormally long retardations of such signals, returned from the upper atmosphere, were first announced by A. H. Taylor and L. C. Young (*Proc. Inst. Radio Eng.*, vol. 16, May 1928), who, in experiments carried out between Rocky Point and Washington, obtained retardations corresponding to a distance of transit of 2900 km. to 10,000 km., although the great circle distance between the stations was only 420 km. In discussing these experiments in a paper at the Brussels meeting of the Union Radio Scientifique Internationale in September last, it was pointed out that wireless waves, meeting the ionised layer at vertical incidence, would travel upwards until they were 'reflected' at a point where the group velocity was reduced to zero, and that if the ionisation gradient in this region was not large, the waves might be appreciably retarded before and after reaching the critical value of ionisation. Put quantitatively, the retardation of any signal sent up from the ground and received there again is $\frac{1}{c}\int\frac{ds}{\mu}$ (where c is the velocity of radiation *in vacuo*, ds an element of path, and μ the refractive index), and this quantity may greatly exceed $\frac{1}{c}\int ds$ if μ is very small for an appreciable part of the path.

Now the retardations observed by Engineer Hals and Prof. Størmer are much longer than those observed by Taylor and Young, but that intermediate values are sometimes obtained is evidenced by some work carried out in this laboratory by Mr. R. L. A. Borrow, who has succeeded in getting photographic registration of the echoes from Eindhoven (PCJJ) corresponding to retardations of 1 sec. The question arises whether waves of 30 metres can remain travelling with a low group velocity in the ionised layer for such a long period as 10 sec. and yet be of appreciable intensity on arriving again at the ground. As possible paths we might consider the waves as travelling round the earth in the ionised layer or as travelling horizontally into the sunset (or sunrise) discontinuity in the layer and being reflected there. If we consider the group velocity to be small, the calculation of the attenuation experienced by the waves turns out to be simple, the signal intensity being reduced to $e^{-ft/2}$ of its initial value, where f is the frequency of electron collisions with air molecules and t is the time of retardation in the layer. If we assume commonly accepted values for f at 250 km. above the earth's surface, a signal of 10 sec. retardation would be e^{-5000} of its original value, while at 400 km. the corresponding figure would be e^{-50}. Thus, unless the ordinarily accepted values of f are considerably in error, the attenuation of signals retarded by travelling at these heights would be very great. But if there were sufficient ionisation at heights of 600 km. or more, it is certain that retardation without much absorption could take place, although our inadequate knowledge of the values of f for such regions precludes a more quantitative statement.

There is, however, another possibility. If we think of the ionised layer as a 'reflecting' shell, the waves sent out by an emitting station will converge to some point near the Antipodes, which, in turn, may be regarded as a source from which another set of waves emerges. Now it is known that conditions in the layer alter very rapidly, so that the points to which the waves converge every $\frac{1}{7}$ sec. (the time of a circumferential journey) will vary rapidly. It thus may be some seconds before a particularly loud repetition of a signal reaches a particular region of the earth.

In conclusion, it may be pointed out that information relating to the question of terrestrial or extra-terrestrial 'reflection' may be obtained by testing whether waves of 30 metres, meeting the layer at approximately vertical incidence, actually penetrate it. Experiments to decide this point for slightly longer waves have been carried out in transmissions between the National Physical Laboratory and this laboratory as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research, and it is hoped that similar tests may be made on 30 metres shortly.

E. V. APPLETON.

Wheatstone Laboratory,
King's College, W.C.2,
Nov. 27.

The Hydroxyl Radical in Flames.

THE evidence in favour of the view that the hydroxyl radical is present in flames has been summarised recently by Bonhoeffer and Haber (*Z. Phys. Chem.*, 137, 263; 1928). There is no doubt that this radical is the emitter of the 3064 A. band, present in the spectra of hydrogen flames, and Hulthén and Zumstein, and Bonhoeffer have shown that this band occurs in absorption when water vapour is heated to high temperatures. The discovery of the existence of this radical in flames has an important bearing on the development of our knowledge of mechanisms of the

reactions occurring in hydrogen and hydrocarbon flames.

The infra-red radiation from hydrogen flames is usually ascribed to the water molecule, on the grounds that so many of the emission bands of water vapour (600° C.) and absorption bands of water vapour (700° C.) agree with the emission bands from the flame (Paschen, *Ann. der Phys. und Chem.* **52**, 214; 1894). If, however, the hydroxyl radical is present in water vapour at high temperatures, then some of the infra-red emission from the flame may be due to it and not to water vapour. Confirmation of this idea is obtained from a study of measurements of the total radiation (mainly infra-red) from flames of hydrogen and oxygen with varying compositions.

The radiation from this flame has been measured by the methods described previously (Garner and Johnson, *Jour. Chem. Soc.*, 280; 1928). The mixed

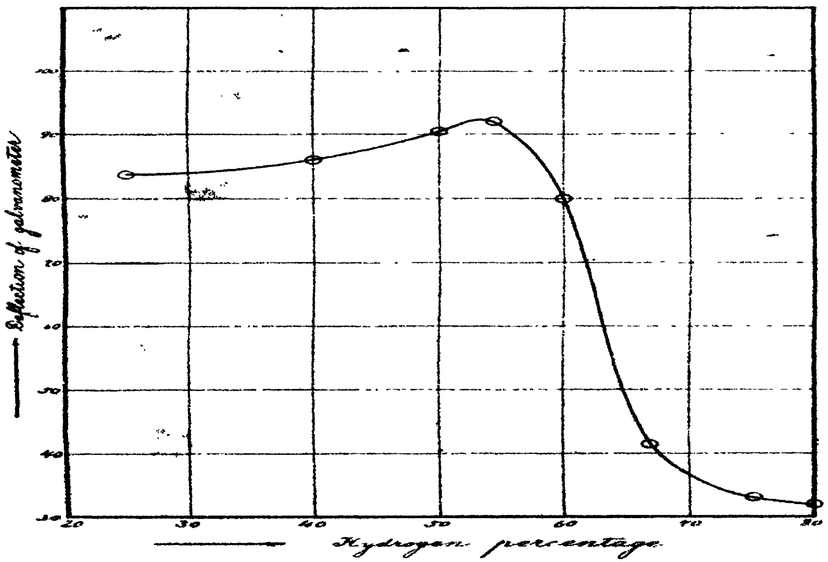

FIG. 1.

gases were burnt in a cylindrical bomb 40 cm. long and 2·5 cm. diameter, at an initial pressure of 1 atmosphere. The radiation emitted through a fluorite window was measured by means of a Moll thermopile and a Downing galvanometer. The results are shown for a number of mixtures of oxygen and hydrogen in Fig. 1, where the galvanometer deflections are plotted against percentage composition. The deflections have been corrected so that in all cases they correspond to the radiation from the same quantity of burnt gas. The results are of a preliminary character, and the position of the maximum is not known accurately.

The maximum emission of radiation does not occur for the mixture of two volumes of hydrogen with one of oxygen, which would be expected, since this mixture gives the highest flame temperature. It occurs for the mixture $H_2 + O_2$ very nearly, which indicates that the hydroxyl radical may be responsible for the emission of part of the radiation from the hydrogen flame.

On this assumption it is possible to explain the above curve. If the hydroxyl radical is produced as a first stage in the reaction between H_2 and O_2,

$$H_2 + O_2 \longrightarrow 2OH,$$

and it emits a fraction of the energy of chemical change as chemiluminescence, then the quantity of radiation emitted will depend on its average duration of life. The hydroxyl radical will undergo reaction in the presence of hydrogen to give water at a rate which will depend on the hydrogen concentration. Thus, excess hydrogen will diminish average life of the radical. Excess oxygen would be unlikely to produce such a marked effect as hydrogen, and the decrease on the oxygen side may be due to inelastic collisions, $OH' + O_2 \longrightarrow OH + O'_2$.

K. TAWADA.
W. E. GARNER.

The University, Bristol.

Molecular Hydrogen in Sunspots.

WHILE carrying out research on the elements of rare earths in sunspots, I happened to notice some lines in a photograph taken at the Arcetri solar tower by Prof. G. Abetti which, so far as I know, have not been hitherto identified. These lines, which were relatively intense in the spots, and very faint, or entirely absent in the photosphere, may be attributed to the secondary spectrum of hydrogen, that is, to the molecular spectrum.

The photograph was taken in the second order with dispersion 1 A. = 1 mm., and comprised the red portion of the spectrum between λ5900 to λ6200, one of the regions where partial bands of striking intensity appear in the secondary spectrum. It will be noted that the region photographed does not include bands of calcium hydride, which covers a large portion of the spot spectrum with very numerous and very crowded lines, rendering it impossible to identify, with any certainty, the lines of the secondary spectrum.

Since experimental data and thermodynamical considerations do not conflict with the presence of molecular hydrogen under the conditions of temperature and pressure prevailing in the spots (4000° K. and 10^{-2} or 10^{-3} atm.), I resolved to compare a wider region of the spot spectrum with the secondary hydrogen spectrum to ascertain whether coincidence between the two spectra might strengthen the hypothesis of the presence of molecular hydrogen.

For this purpose I made use of the recent and accurate measurements of the secondary spectrum of hydrogen carried out by H. G. Gale, G. S. Monk, and K. O. Lee (*Astrophys. Jour.*, **67**, 89; 1928), and of a large scale map (0·25 A. = 1 mm.) of the sunspot spectrum taken at Mt. Wilson, a copy of which is in the Arcetri Observatory. This map, prepared by Ellerman at the great solar tower, using the polarising system for the study of magnetic fields, has not yet been published. The comparison, which was extended to the region between λ6400 and λ4450, shows numerous coincidences with a maximum error of about ± 0·03 A. in the I. A. system.

I noticed, further, that all the lines which are presumed to be those of the secondary spectrum of hydrogen show no trace of the Zeeman effect as is seen in the map. In fact, they behave exactly as do the lines of calcium hydride, magnesium hydride, etc., also present in the spots. This means that molecular hydrogen can be present in the higher regions of a sunspot, beyond the influence of the magnetic field, where the possibility of the existence, at least of certain molecules, is positively assured.

GIORGIO PICCARDI.

Istituto di Chimica Generale
della R. Università, Via Gino Capponi 3,
Firenze, Italy.

International Commission on Zoological Nomenclature.

THE undersigned has the honour to invite the attention of the zoological profession to the fact that Opinions 98 to 104 have been published by the Smithsonian Institution (*Smithsonian Miscellaneous Collections*, vol. 73, No. 5). The summaries read as follows:

Opinion 98.—Rigidly construed, Brauer and Bergenstamm (1889 to 1894) did not fix the types for the older generic names, except in the cases where they distinctly state that the species mentioned is the type of the genus.

Opinion 99.—*Entamœba* 1895, with *blattæ* as type by subsequent (1912) designation, is absolute synonym of *Endamœba* Leidy, 1879*a*, p. 300, type *blattæ*, and invalidates *Entamœba* 1895, type by subsequent (1913) designation *hominis* = *coli*.

Opinion 100.—Under suspension of the rules the genotype of *Spirifer* Sowerby, 1816, is fixed as *Anomia striata* Martin, and the genotype of *Syringothyris* Winchell, 1863, is fixed as *Syringothyris typa* Winchell (= *Spirifer carteri* Hall).

Opinion 101.—The technical Latin designations used by Danilewsky, 1891, *Annales de l'Institut Pasteur*, vol. 5 (12), pp. 758-782, are not in harmony with the International Rules of Zoological Nomenclature, and are therefore not subject to citation or the law of priority on basis of said publication.

Opinion 102.—A generic name (example, *Proteocephalus*, 1858) is not invalidated by the earlier publication of the identical or a similar name of higher rank (example, *Proteocephala*, 1828). If *Tænia ambigua* (tod. of *Proteocephalus*, 1858) is congeneric with *ocellata* (tsd. of *Ichthyotænia*, 1894), *Ichthyotænia* is a subjective synonym of *Proteocephalus*.

Opinion 103.—The type of *Grus* Pallas, 1767, is *Ardea grus* Linn., 1758, by absolute tautonymy. *Grus* is hereby placed in the official list of generic names.

Opinion 104.—The following 57 generic names, with type species cited, are hereby placed in the official list of generic names:

Protozoa: *Bursaria*, *Eimeria*, *Laverania*, *Plasmodium*, *Sarcocystis*; Cestoda: *Ligula*; Nematoda: *Filaria*, *Heterodera*, *Rhabditis*, *Strongylus*, *Syngamus*; Oligochæta: *Enchytræus*; Hirudinea: *Hæmadipsa*, *Limnatis*; Crustacea: *Armadillidium*, *Astacus*, *Cancer*, *Diaptomus*, *Gammarus*, *Homarus*, *Nephrops*, *Oniscus*, *Pandalus*, *Penæus*, *Porcellio*; Xiphosura: *Limulus*; Scorpionidea: *Scorpio*; Araneæ seu Araneida: *Avicularia*, *Dendryphantes*, *Dysdera*, *Latrodectus*, *Segestria*; Acarina: *Cheyletus*, *Chorioptes*, *Demodex*, *Dermanyssus*, *Glyciphagus*, *Polydesmus*, *Psoroptes*, *Rhizoglyphus*, *Trombidium*; Thysanura: *Lepisma*; Collembola: *Podura*; Orthoptera: *Blatta*, *Ectobius*, *Gryllus*, *Periplaneta*; Anoplura: *Pediculus*, *Phthirus*; Hemiptera: *Anthocoris*, *Nabis*, *Notonecta*, *Reduvius*, *Triatoma*; Dermaptera: *Forficula*; Suctoria s. Siphonaptera s. Aphaniptera: *Pulex*; Mammalia: *Cercopithecus*.

C. W. STILES
(Secretary to the International Commission on Zoological Nomenclature).
Washington, D.C.

A Psychological Analysis of Radicalism.

HAVING recently travelled round the world, and come in contact with various types of radicalism, especially in Russia and India, I have thought it possible that some form of analysis might facilitate clearer thinking. It is possible to recognise three types:

(1) Emotional radicalism.
(2) Mechanical radicalism.
(3) Rational radicalism.

By radicalism we mean the attitude of seeking or promoting radical or fundamental reforms. In the first type we witness a desire for reform, without any sufficiently considered programme. Formerly we had a party in the United States called the Populist Party. It had considerable success at first, as a party of justifiable indignation or protest, but having no well-reasoned plans it became extinct. Some one wittily defined a populist as "a man who doesn't know what he wants, but wants it damned bad." The second type is built on a theory or dogma, and is well illustrated by Marxian or Leninian socialism. In Russia, furious debates arise over the question, What would Marx, or what would Lenin, have said or done in existing circumstances? The third type, to which many scientific men belong, is pragmatic, and depends upon the close and constant study of all the factors involved.

The first and third types involve more thought than the second; but in the first the attitude is primarily subjective, in the third more objective. Rational radicalism, while abundantly distinct from the other two, partakes in some measure of their qualities. Thus it necessarily has to be based on fixed principles, the laws of Nature; and it gets its driving force from those emotions which come from a sense of human values, regardless of mechanistic or cosmic considerations. Emotional radicalism is the easiest, and may even be said to be displayed by children when they resent discipline. Rational radicalism is the hardest, and at different times may be the most conservative or cautious, or the most progressive and venturesome. Its programme varies with circumstances, and with the completeness of our knowledge and accuracy of our judgments.

T. D. A. COCKERELL.
University of Colorado,
Boulder, Colorado, Oct. 30.

Long Wave Radio Reception and Atmospheric Ozone.

I AGREE with Dr. Dobson (NATURE, Nov. 10, p. 725) that the relation that has been found between Bangalore observations on Madras and the ozone values for north-western Europe requires extended observations for confirmation. Far from being an assertion of an established relation, my letter was intended to direct attention to the probable connexion as shown by the correlation figure of $0 \cdot 88 \pm 0 \cdot 023$.

Dr. Dobson is no doubt aware of the periodic variations in radio field intensity as well; this has been shown by Austin, Mesny, and other observers. The Bangalore observations on Madras, too, indicate the same. In addition to the seasonal variations noted by every observer, we have also an annual increase in intensity, specially marked in the observations on Bordeaux, at Meudon, and at Washington, with fairly definite similar variations in sunspots (Wolfer's figures).

In the present case, considering the great distance and the period of comparison—six months—the relation found was so unexpected that a common cause for the variations suggested itself; if true, it would mean that the variations in ozone values would not partake of a strictly local character.

In view, however, of Dr. Dobson's statement that in lower latitudes the annual variations of ozone are comparatively small, it would be interesting to know if there is any similarity in the variations at low latitudes, such as they exist. The actual ozone value

 B 2

will no doubt, as Dr. Dobson says, depend on the locality itself.

While taking the greatest care in the examination of observations, any probable connexion should not be overlooked. K. SREENIVASAN.

643 Fulham Road, London, S.W.6.

Higher Hydrocarbons from Methane.

MESSRS. Stanley and Nash, in their interesting letter on the production of higher hydrocarbons from methane, NATURE, Nov. 10, p. 725 (cf. also Prof. Wheeler's comments, Nov. 17, p. 773), have inquired whether the carbon which is formed during the thermal decomposition of methane could combine with hydrogen to form gaseous hydrocarbons.

In attempting to extend the methods of measuring the area of catalytically active surfaces to non-metallic surfaces (*Proc. Roy. Soc.*, A. vol. 119, p. 196; 1928) I have studied the action of a graphite surface supported on china clay rods on methane, ethylene, acetylene, propylene, and hydrogen. The graphite film was heated by an electric current to temperatures varying from 800° C. to 1200° C., estimated by a disappearing wire optical pyrometer. In the case of these hydrocarbons, gas carbon was always deposited on the exterior of the graphite film. A good deposit of carbon was also found in the pores of the china clay rods, so much so that the initially white rod was turned black throughout, and the rate of diffusion of gas from the centre of the rod to the outside was cut down ten times by heating for 5 min. at 1100° C. in propylene.

During the experiments with methane and propylene, these gases were suddenly removed and replaced by pressures of 5, 10, 20, and 50 cm. of pure hydrogen. In only one case was there any change in the pressure of the hydrogen introduced, this being a slight increase in pressure of 0·15 cm. mercury, and fully accounted for by the fall in the barometric pressure during the experiment.

The conclusion seems evident that under these conditions the carbon deposited is incapable of combining with hydrogen at any appreciable speed. Whether carbon could combine with hydrogen at the instant of deposition seems doubtful.

F. HURN CONSTABLE.

St. John's College, Cambridge.

Rotation of Molecules induced by Light.

IN an earlier note to NATURE (Aug. 25, p. 278) we ventured to suggest that the nebulosity or wings which accompany the original lines of the mercury arc after scattering in benzene liquid, are the effect of those collisions of the incident light-quanta with the molecules which result in a change of their rotational state. At the present time we are not very clear as to the conditions under which a spin may be set up in the molecule when it collides with a light-quantum. It appears, however, reasonable to suppose that the probability of such spin being induced should depend, among other factors, on the degree of optical anisotropy of the molecule.

In agreement with this supposition it is found that while the aromatic compounds such as benzene, toluene, pyridine, etc., which have a strong optical anisotropy, exhibit the wings of the scattered lines in a striking manner, the aliphatic compounds such as carbon tetrachloride, ether, alcohol, etc., which are much more nearly isotropic optically, exhibit the effect only very feebly. A further confirmation of this idea is furnished by photographs of the scattered spectrum from carbon disulphide taken by Mr. P. V. Krishnamurthy in our laboratory.

It is well known that the carbon disulphide molecule has a high degree of optical anisotropy. The photographs show, as expected, besides some displaced lines, also strong wings accompanying the original lines of the mercury arc. Incidentally, we may mention that the wings appear to consist of unpolarised light.

C. V. RAMAN.
K. S. KRISHNAN.

210 Bowbazar Street,
Calcutta, Oct. 18.

The Chromomeres of *Lilium*.

IN specially well-fixed preparations of the pachyphase (pachytene stage) of *Lilium*, stained with iron-brazilin, the following phenomena were observed:

The homologous chromomeres of the two conjugated threads are split, and the two halves of each (chromioles) remain in contact (as Gelei also found; *Archiv f. Zellforsch.*, 22; 1921).

These two pairs of chromioles become joined (if small) by transverse threads (as Gelei also observed), and if large by lateral fusion.

Rather often both the sister chromioles of one homologue do not unite with their partners, but only one unites. Thus a transverse V is formed. Sometimes a number of such V's follow one another in the thread.

In a small percentage of cases the two sister chromioles of one chromosome are not equal to the homologous pair, but are much smaller.

In a somewhat larger number of cases, both homologous chromomeres are markedly smaller than the general size (although this is variable). They are connected by two transverse threads. This double connexion is an indication that they are divided, which is not otherwise visible.

In quite a small percentage of cases only one homologous chromomere is visible. It is large and well stained, sometimes showing indications of division into two. On the other side there is a blank, and there are no transverse threads.

JOHN BELLING.

Carnegie Institution of Washington,
Department of Genetics,
Cold Spring Harbor, New York, U.S.A., Oct. 1.

The Electrical Conductivity of Metals.

IN the recent theories of metallic conduction the exchange of electrons between neighbouring atoms has perhaps not been sufficiently considered. The new quantum mechanics as applied to molecules has shown that, for distances of the order of those which separate the atoms in a crystal lattice, electrons go over from one atom to the other more than 10^{10} times per sec. Roughly, this frequency of interchange is a function of the nuclear charge, of the number of the electrons per atom, as well as of the average distance of the atomic neighbours (number of atoms per cell; temperature). These variables have been shown by K. F. Herzfeld (*Phys. Review*, vol. 29, p. 701; 1927) to be decisive in making an element a metallic conductor. An applied external field will favour the rate of exchange with the neighbours lying in the direction of the electric field, and cause a flow of electrons in one direction. For certain appropriate values of the atomic properties, super-conductivity may result.

By admitting this sharing of electrons it is possible to account for the magnetic properties of single metal crystals of zinc and cadmium, which have recently been investigated at my suggestion (*Proc. Roy. Society*, in course of publication; NATURE, Mar. 10, 1928.)

[illegible] RUEDY.

Toronto.

Production and Properties of High-frequency Radiation.[1]

By Sir ERNEST RUTHERFORD, O.M., Pres. R.S.

IN my address last year I referred to recent advances in the production of very high voltages for technical purposes, and the application of these voltages to highly exhausted tubes in order to obtain a copious supply of high-speed electrons and atoms and high-frequency radiation. It is of interest to note how rapidly in recent years our ideas have widened as to the possibilities of production of very high-frequency radiation of the X-ray type, both by artificial and natural processes.

On the quantum theory, the energy associated with a quantum of radiation of frequency ν is given by $h\nu$, where h is the well-known constant of Planck. When swift electrons impinge on matter, radiation of an X-ray type is generated over a wide range of frequencies, and it has been verified experimentally that the maximum frequency of the radiation obtainable in this way is limited by the relation $E = h\nu$, where E is the energy of motion of the electron, a result in accordance with energy considerations.

For purposes of discussion, it is very convenient to express the energy of a quantum not in ergs but in terms of a potential difference in volts, through which an electron must fall to acquire an equal energy. Expressed in this way, the energy of a quantum of green light corresponds to 2 electron-volts, or 2 volts for brevity. Before the advent of X-rays the highest frequencies examined were confined to the ultra-violet part of the light spectrum, corresponding to less than 10 volts. Following the discovery of X-rays and the application of methods for determining their frequency, we have been enabled to study radiations over a wide range of individual energy, varying from a few hundred volts to 300,000 volts or more. By the use of special gratings and other methods, the gap in frequency between ordinary ultra-violet light and soft X-rays has been bridged in the last few years. There appears to be no limit to the maximum frequency that can be obtained by the bombardment of matter with electrons, except the practical difficulty of obtaining streams of the requisite high-velocity electrons. In some recent experiments in the Institute of Technology, Pasadena, about 1 million volts has been successfully applied for a short time to a suitably designed X-ray tube. It is stated that the X-rays obtained were of such intensity and penetrating power that they could easily be observed by the luminosity on a phosphorescent screen 100 feet away.

So far our experiments in this direction have been limited to about 1 million volts, and we have not yet been able to produce X-rays in the laboratory of penetrating power equal to that shown by the γ-rays spontaneously emitted by radioactive bodies. The highest frequency observed in their transformations corresponds to between 3 and 4 million volts. Some recent experiments indicate that the γ-rays which accompany the weak radioactivity of potassium are of still greater penetrating power than the rays from radium, but no definite estimate of the maximum frequency has so far been made.

There is in addition another general method of estimating the frequency of radiation that may arise in certain fundamental atomic processes of a simple type. According to modern views, energy and mass are closely connected, and the relation between the energy E resident in a mass m is given by the well-known equation of Einstein, $E = mc^2$, where c is the velocity of light. According to this view, if any system decreases in mass by internal rearrangement, the total energy lost in the process is given by the product of the change of mass multiplied by c^2. If this energy is emitted in the form of a radiation of one definite frequency ν, then $h\nu = c^2dm$, where dm is the accompanying change of mass of the system. On account of the very small change of mass even for a large emission of energy, it is difficult to give a direct experimental proof of this relation, but there seems to be little doubt of its general validity. Even for the radioactive bodies which in their successive transformations spontaneously emit a very large amount of energy per atom, in the form of α-, β- and γ-rays, the effect to be expected is small and difficult to measure. The atom of uranium of mass about 238, after successive transformations involving the loss of eight α-particles, changes into an isotope of lead of mass about 206. It is to be anticipated that, if the methods of positive ray analysis could be applied to these elements, the difference between the atomic masses of uranium and the resulting lead would include not only the mass of 8 helium nuclei in the free state, but also about 0·05 unit of atomic mass, corresponding to the total emission of energy of about 46 million electron-volts per disintegrating atom of uranium. This difference —about 1 in 4000—should be just detectable by the methods employed by Aston in his study of isotopes. Similarly the change of mass in each transformation can be deduced if the energy released during the process is known experimentally.

We shall now consider the application of these ideas to certain nuclear processes. It is now generally accepted that the nuclei of all the elements are composed of protons (hydrogen nuclei) and electrons. While it is of course difficult to give a definite proof of this hypothesis, we know that it is strongly supported by the work of Aston on the atomic masses of the isotopes of the elements and by the experiments on the liberation of protons from certain light elements when bombarded by swift α-particles. It is generally supposed that the helium nucleus is composed of a close combination of four protons and two electrons. The mass of the helium atom is 4·00216 ($O = 16$), while the mass of four hydrogen atoms in the free state is $4 \times 1{\cdot}00778$. There is in consequence a loss of

[1] From the address delivered at the anniversary meeting of the ... on Nov. 30.

mass of 0·029 in the formation of the helium atom. This indicates a loss of energy of 27 million electron-volts in the process of building a helium nucleus from free protons and electrons. If it be possible to imagine that in some way this energy is emitted catastrophically, in a single quantum of radiation, the energy of the quantum would correspond to 27 million volts. The energy emitted per atom is thus very large, and it has been suggested by Eddington and others that the formation of helium from hydrogen nuclei and electrons may be one of the sources of the energy radiation from the stars.

In a similar way the total energy emitted during the formation of any atom of known mass from free protons and electrons may be estimated. Since the proton in a free state has a mass 1·0073, and a mass about 1·000 in the average nuclear combination, the energy released per proton is about 7 million volts. For example, the atomic weight of the most abundant isotope of mercury (atomic number 80) is 200·016, and this presumably contains 200 protons, of mass nearly unity, and 120 electrons. Disregarding the small mass due to the electrons, we may conclude that the total energy emitted during the formation of a mercury atom from free protons and electrons is about 1400 million electron volts.

When we consider the extreme complication of such a heavy nucleus and the number of its component parts, it is difficult to believe that this emission of energy can take place in one single catastrophic act. It is so much more likely that the energy is emitted in a step-by-step process during the organisation of the nucleus. Except for light atoms, where the nuclear structure is simple, it is to be expected that the radiation of energy from all complex nuclei would occur in successive stages.

On the other hand, there is one possibility to consider, which was first put forward by Jeans to account for the long lives of the hot stars. He supposes that even the protons and electrons are not indestructible, but may under unknown conditions be transformed into radiation. The total internal energy of the electron is about 500,000 volts, but of the proton 1840 times greater, or about 940 million volts. If we suppose the proton and electron to disappear together in the form of radiation, there must be an enormous liberation of energy. If this energy be emitted in a single quantum, we should expect to obtain a γ-radiation corresponding to about 940 million volts. Such a hypothesis is admittedly of a very speculative nature and may be very difficult of direct proof or disproof.

Apart from the radioactive bodies we have no definite experimental evidence of the emission of penetrating radiations, either in the formation of atoms or destruction of protons, and it may be that the processes considered do not take place under the conditions of our experiments on the earth. On the other hand, the long life of the hot stars indicated by [illegible] astronomical evidence does seem to dema[illegible] some such process or processes in which the liberation of energy is enormous compared with the mass involved.

It is thus of very great interest to examine whether any direct experimental evidence can be obtained of the existence of such extraordinarily energetic γ-rays. This interest is heightened by the experiments in recent years which have shown the existence of an extremely penetrating type of radiation, sometimes called the 'cosmic' rays, in our atmosphere—a radiation much more penetrating than the γ-rays from the radioactive bodies. This radiation has been detected and measured by the small ionisation produced in a closed electroscope. The initial observations were made by Hess and by Kolhörster, and we owe much to the admirable experiments of Millikan and Cameron, who have carefully examined the absorption of this radiation by the water of mountain lakes, which are practically devoid of ordinary radioactive matter.

It is clear from these experiments that the radiation is complex in character, and that there are present radiations which are able to pass through 17 metres of water for a reduction of intensity to one-half value. It is natural to suppose that this radiation is of a γ-ray type, but it should be borne in mind that the effects so far observed would be equally explicable if the radiations consisted not of high-frequency γ-rays, but of high-energy electrons entering our atmosphere.

Assuming, however, that the radiation is of the γ-ray type, it is necessary to consider the factors that determine the absorption of such a radiation by matter. During the past twenty years the problem of the nature of the absorption of X-rays and γ-rays by matter has been the subject of detailed investigations, and there is now a general consensus of opinion of the main features of the processes involved. In the case of the heavier elements, the absorption of ordinary X-rays is mainly due to the interaction between the radiation and the electrons in the atom, whereby the energy of the quantum of radiation is transferred to the electron. This is generally known as the 'photoelectric' effect. In addition, there is a relatively small loss of energy due to the scattering of the incident radiation by the electrons; but in general, except for very high-frequency X-rays and light elements, the absorption due to the photoelectric effect predominates. The case is quite different when we deal with penetrating γ-rays, where the loss of energy due to the process of scattering becomes relatively much more important, and for radiation of the order of 100 million volts almost completely governs the absorption.

The main features of this scattering, known as the Compton effect, are now well understood. There is an occasional interaction between the quantum of radiation and the electron in an atom, whereby the radiation is scattered and the electron set in motion. The scattered radiation is always of lower frequency than the incident radiation, the difference depending on the angle of scattering. In this type of encounter between radiation and an electron, both momentum and energy are conserved, and consequently the energy given to the electron depends on the nature of the encounter and thus on the angle of scattering of the radiation. The

essential correctness of this theory has been verified by several distinct methods.

When a pure radiation of definite frequency is passed through matter, there always remains some transmitted radiation which has not been transformed, but mixed with it are degraded radiations of much lower frequency and swift electrons set in motion by the process of scattering. The ionisation observed in a closed vessel is probably mainly due to the electrons liberated by scattering in the medium and the walls of the containing vessel.

Assuming that the laws of the Compton process of scattering are valid for high-frequency radiation, there still remains the difficulty of estimating the probability of such scattering encounters, for on this probability depends the actual magnitude of the absorption coefficient. Different methods of calculating this probability have been given by A. H. Compton, Dirac, and recently by Klein and Nishina. The theory of Compton is based mainly on classical analogies, and that of Dirac on the earlier quantum mechanics. Recently the problem has been attacked again by Klein and Nishina (NATURE, Sept. 15, 1928), using the later relativistic form of wave-mechanics formulated by Dirac. The calculated absorption coefficients for high-frequency radiations differ materially from one another on these three theories, and in particular the theory of Klein and Nishina gives a greater absorption coefficient for a given high-frequency radiation. For radiations of individual energy more than 100 million volts, the coefficient is about five times greater than that given by the formula of Dirac.

Unfortunately, the experimental evidence available from a study of the absorption of the most penetrating γ-rays from radioactive bodies is not complete enough to give a definite test of the validity of these theories. However, Mr. Gray, of the Cavendish Laboratory, who has made a careful examination of existing data on the absorption of γ-rays, informs me that the evidence as a whole is more in accord with the theory of Klein and Nishina than with the earlier theories of Compton and Dirac. It is evident, however, that in view of the importance of the question, a careful determination is required of the absorption and scattering of γ-rays of as definite frequency as possible in order to distinguish between the various theories.

It is of interest to note that the absorption coefficient of the most penetrating type of radiation deduced by Millikan and Cameron from their experiments is in excellent accord with that to be expected on the Klein-Nishina theory for a quantum of energy 940 million volts—the energy demanded for the transformation of the internal energy of the proton into radiation. Although this agreement is suggestive, our theories of absorption are at present too uncertain to place much weight upon it. Even if subsequent experiment should prove the correctness of an absorption formula within a certain range of frequency corresponding to the γ-rays, there would still be the need of extrapolating the formula over a very wide range, say from quantum energies of 2 million volts to 1000 million volts, to include the ultra-penetrating rays observed in our atmosphere.

In addition, there are a number of new factors which may have to be taken into consideration when we are dealing with the passage of very high-frequency radiation through matter. In the ordinary theories, the scattering of the radiation is supposed to be confined to the extra-nuclear electrons, but if we are dealing with a quantum of energy corresponding to the order of 100 million volts, it is not unlikely that the nuclear electrons may be effective in scattering as well as the outer electrons. Such an effect is to be expected if the energy of the quantum is large compared with the energy required to release an electron from the nucleus. In addition there is always the possibility and even the probability that such energetic radiations or the swift electrons liberated by them may be able occasionally to disintegrate the nucleus of the atom in their path.

For all these reasons, it is evident that much more information is required before we can draw any but tentative conclusions as to the nature of the penetrating radiations in our atmosphere. So far, experiments have been mainly confined to measuring the ionisation produced in a sealed electroscope. Further experiments are required which will give us definite indication of the energy of the swift electrons present in the atmosphere, for this will give us valuable information on the maximum frequency of the radiation present, quite independently of the exact accuracy of our theories of absorption.

Continued observations made in a Wilson expansion chamber should throw much light on the nature of the particles which produce the ionisation in a closed vessel, and with the addition of a magnetic field of sufficient intensity the curvature of the tracks of β-rays should enable us to determine their individual energy. Experiments of an analogous kind have already been made with an expansion chamber by Skobelzyn, in order to determine the relative intensities of the main γ-rays emitted by radium C. In the course of these experiments he has observed on several occasions the trails of very energetic β-particles, probably arising from the ultra-penetrating radiation in our atmosphere. During the present year Prof. Hans Geiger has developed a modified form of β-ray counter which records each β-particle entering a vessel of considerable volume in any direction. This new method is so delicate that it may prove very useful in counting and even recording the number of β-particles produced by the penetrating radiation.

While it is to be hoped that in the years to come we may have available for study in our laboratories swifter β-rays and higher frequency radiation than we have to-day, we can scarcely hope in the near future to produce artificially radiations, atoms, and electrons which have an individual energy of the order of 100 million to 1000 million volts, such as are present in our atmosphere.

It is thus of great interest and importance to use

every promising method of attack to throw light on the nature and origin of these penetrating radiations and the effects arising in their transmission through matter. The magnitude of the effects to be observed is small and not easy to measure with accuracy; but with the ever-increasing delicacy of methods of attack we may hope to gain much further information. The study of these extraordinarily penetrating radiations is not only of great interest in itself, but also for its promise of throwing new light on fundamental processes in our universe connected with the building up and destruction of atoms. It may take many years of faithful experiment before the evidence is sufficient to test the correctness of the numerous interesting speculations that have been advanced to account for the origin and nature of these radiations.

Copper in Antiquity.

ON more than one occasion attention has been directed to the work of the British Association Research Committee which is investigating the sources of Early Sumerian copper. The interim report which was presented at the recent Glasgow meeting of the Association is of exceptional interest. It embodies a report by Prof. C. H. Desch which would appear to point to a possible source from which copper reached Mesopotamia in early times. It is scarcely necessary to say that the quantity of copper and bronze objects found is one of the not least remarkable features of recent excavations on early sites in Sumeria. It has almost revolutionised our conception of the early stages in the growth of civilisation.

The method followed by the Committee has been to analyse chemically as many samples of ancient copper and bronze objects as could be obtained for comparison with the analyses of ores from the various areas in which supplies of copper might have been accessible to the Sumerians. Examples of early date from areas other than Sumeria have also been analysed for purposes of comparison. In the present report, for example, Prof. Desch deals with objects from Susa, Ur, Kish, Bahrein Island, Egypt, including the sheet metal of the statue of Pepy I, now in the Cairo Museum, and North Arcot, India. Specimens from Mohenjo-Daro are still under examination, and samples from other localities still await attention. Egyptian fragments from various sites supplied by the Ashmolean Museum, Oxford, too small for analysis, were examined spectroscopically. Ores were obtained from Anatolia, Persia, Arabia, and Egypt. Prof. C. O. Bannister, as well as Prof. Desch, has taken part in the work of analysis.

An analysis of three specimens of bronze from the first grave at Ur, dated about 3500 B.C., showed that notwithstanding their early date, they consisted of a tin bronze, with nickel as a characteristic impurity. The figures were as follows:—

	A per cent.	B per cent.	C per cent.
Copper	84·18	85·13	85·01
Tin	12·00	11·78	14·52
Lead	1·62	1·13	0·47
Nickel	2·20	0·25	trace
Iron	—	1·71	—

Specimens obtained from the excavations at Kish in 1928 also contained nickel, though in smaller quantities, while of specimens obtained in 1925, copper from Mound A (3000 B.C.) showed nickel 3·34 per cent, and bronze from Mound W (Nebuchadnezzar) showed of nickel a trace, with 4·65 of tin and 6·16 of iron. Samples from Tel-el-Obeid showed respectively nickel 0·12 (from the frieze) and 0·23 (a nail); but a nail from Iraq of 2000 B.C. yielded no nickel.

In no case was there antimony.

Bronze dated with some probability at 1200 B.C. obtained by Sir Flinders Petrie from tumuli in Bahrein Island, yielded nickel in two cases in a percentage of 0·27 and 0·52. These specimens in the quantity of sulphur present showed evidence of imperfect smelting, while the proportion of tin present in some was so high as to render the bronze too brittle.

Among the Egyptian samples, the sheet metal from the statue of Pepy showed a remarkably high percentage of nickel—1·06. The Egyptian specimens examined spectroscopically showed no traces of gold or nickel. Some were pure copper, others showed traces of iron and arsenic, with, in one case, tin 5·25 per cent. The North Arcot specimens had 0·25 per cent of nickel.

Prof. Desch quotes analyses of three objects by Von Bibra from the North-West Palace of Nineveh found by Layard, containing 0·18, 0·30, and 0·20 per cent of nickel respectively, while J. Sibelien found 0·28 per cent of nickel in a Sumerian statuette (about 3000 B.C.) and 0·43 per cent in a copper adze of the First Egyptian Dynasty.

Having these results in view, and having regard to the fact that nickel is by no means an invariable constituent in copper ores, the aim of the Committee is now to find an ore which would be likely to yield nickel in such proportions. Native copper from Angora has yielded copper 99·83, a trace only of tin, 0·17 of iron, and no trace of nickel, while native copper from Arghana with 97·08 of copper, 0·27 of tin, 2·13 of iron, has 0·03 of nickel. A copper chisel of the early dynastic period yielded copper 93·21 per cent, silver 2·51 per cent, gold 4·14 per cent, lead 0·05, and arsenic 0·06 per cent, and was therefore probably composed of native metal.

Ores from Persia, the Black Sea, and the Sea of Marmora, Cyprus, various parts of Egypt and Sinai, yielded no result, all being free from nickel.

(Continued on p. 895.)

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The Quantum Theory.[1]

By Prof. H. S. ALLEN, University of St. Andrews.

IN a lecture on the quantum theory it might be thought fitting to commence with a clear explanation of the purpose, nature, and scope of the subject; but an attempt to answer briefly the question, 'What is the quantum theory?' would prove as baffling as Osborne Reynolds found the answer to the question, What is thermodynamics? He confessed that he felt tempted to reply:

"It is a very difficult subject, nearly, if not quite, unfit for a lecture. The reasoning involved is such as can only be expressed in mathematical language. But this alone should not preclude the discussion of the leading features in popular language. The physical theories of astronomy, light, and sound, involve even more complex reasoning, and yet these have been rendered popular, to the very great improvement of the theories."

The discussion of the quantum theory, however, presents a further and perhaps a greater difficulty. When Osborne Reynolds lectured on the general theory of thermodynamics in 1883, the foundations of the subject had been well and truly laid by the labours of those nineteenth-century leaders of physical science, Carnot, Joule, Clausius, Thomson, and Helmholtz. But even yet we are not quite satisfied as to the foundations of the quantum theory. Builder's rubble is still scattered over the ground, and the building itself is still in process of erection. Although the first stone was laid by Dr. Max Planck, professor of theoretical physics in the University of Berlin, on Dec. 14, 1900, the scaffolding has not yet been removed, and it is difficult, if not impossible, to get a bird's-eye view of the structure.

The quantum theory, though it has not attracted so much popular attention as the theory of relativity, has created problems of equal if not greater philosophical and scientific importance. The most acute question in physics at the present time is the problem of the nature of light. Is light corpuscular or undulatory in structure? In 1905, Einstein first suggested the hypothesis of light quanta. It is as though in digging the ground for the new theory he had unearthed the foundations of Newton's corpuscular theory and employed them in the construction of a new building; and all the time across the way was the magnificent structure of the undulatory theory of light erected by the labours of Huyghens, Young, and Fresnel, and enriched by the genius of Clerk Maxwell.

Up to the present no one has bridged the gulf between these two buildings. Many attempts have been made to build a bridge, but the keystone of the arch has not been fitted. Physicists are obliged to live sometimes in one building, sometimes in the other. We use either hypothesis according to the nature of the problem that we have under consideration, or, as Sir William Bragg expressed it in his presidential address to the British Association at Glasgow:

"On Mondays, Wednesdays, and Fridays we adopt the one hypothesis, on Tuesdays, Thursdays, and Saturdays the other. We know that we cannot be seeing clearly and fully in either case, but are perfectly content to work and wait for the complete understanding."

LIGHT QUANTA.

According to Einstein's hypothesis, the energy of radiation, instead of spreading out in all directions from the source as the undulatory theory of light would lead us to expect, is concentrated in certain bundles or units of energy so that propagation takes place in a manner closely resembling that met with in the corpuscular theory. There are certain phenomena which would lead us to the conclusion that the energy of a quantum is not only definite in amount, but is also concentrated in space, being always confined to a very small volume.

One way of picturing this concentration is to suppose with J. J. Thomson that the energy travels along discrete lines of electric force, so that the front of a wave of light would suggest the appearance

[1] From a lecture on "Some Philosophical Aspects of the Quantum Theory," delivered to the St. Andrews University Philosophical Society, Oct. 29, 1928.

of a number of bright spots on a dark ground. There are serious objections to this particular picture of the propagation of light, but it does seem necessary to suppose that each unit of energy can only be absorbed or emitted as a whole. This hypothesis is consistent with the experimental facts observed when electrons are separated from atoms by the action of light or X-rays—the so-called photoelectric effect. When the light quantum gives up its energy, it may be assumed that the energy is transferred to a single electron, so that the latter leaves the body with a corresponding amount of kinetic energy, allowance being made for the work the electron has to do in leaving the body. Einstein's hypothesis, however, seems inconsistent with the phenomena of interference and diffraction, which require some form of wave theory for their explanation.

The Radiation Problem.

Towards the close of the last century, an unexpected difficulty confronted physicists with regard to the spectrum of the radiation inside a hollow body maintained at a constant high temperature. The light issuing from a small opening in the wall of the enclosure was examined by using a prism, and the energy in different parts of the spectrum was measured. The results of such measurements could not be forced into agreement with classical theory. The latter predicts a definite relation between the energy emitted for a certain wave-length (or, more strictly, for a small range of wave-lengths) in the spectrum and the wave-length of that particular region. The results of the experiments do not conform with this relation.

If we adopt the principles of classical mechanics in dealing with radiation, as was done in an important investigation by the late Lord Rayleigh, there seems no escape from the conclusion that the way in which the energy is distributed amongst the wave-lengths in a normal spectrum must follow a definite mathematical law, now known as Rayleigh's law. According to this law, the energy should be the greater the smaller the wave-length of the radiation considered; in fact, for very short wave-lengths the energy should tend to assume an infinitely great value. This is directly contrary to experience. Careful experiments have shown that the energy of radiation is a maximum for a particular wave-length, and when the wave-length is less than the particular value, the energy is smaller than the maximum, becoming extremely small for the very short waves.

It was to meet this difficulty that Planck assumed the existence of vibrators of frequency ν, which could only possess energies of amount $h\nu$, $2h\nu$, $3h\nu$, . . . and no other. Thus he introduced the hypothesis of energy quanta. According to this hypothesis, radiant energy of any assigned frequency ν can be emitted and absorbed only as an integral multiple of *an element of energy*, $h\nu$, where h is a constant of Nature, now known as Planck's constant.

We may feel some hesitation in speaking of an 'atom' of energy, since the energy depends upon the frequency and the true constant is the factor h; but we may say that the radiation behaves as though it were done up in parcels or bundles, each parcel possessing an amount of energy, $nh\nu$ (n integral), proportional to the frequency of the radiation considered.

Another way of regarding the matter is to pay attention to the factor h itself. This is a quantity having the 'dimensions' of *action*, that is, energy multiplied by time. It is probably significant that, in the theory of relativity, action becomes more important than energy, and action rather than energy is conserved.

There is yet another way of interpreting Planck's constant, and that is to regard it as determining a natural unit of angular momentum (J. W. Nicholson), the physical 'dimensions' of angular momentum being the same as those of action. The angular momentum may be expressed in terms of a unit $h/2\pi$.

Integral Relations in Science.

It is almost impossible to exaggerate the importance which attaches to the occurrences of integers in physical science. Integral relations between the *masses* of gases entering into chemical combination with one another confirmed Dalton's theory of the atomic constitution of matter (1803), a theory first suggested to his mind by a study of the physical properties of gases. The chemical elements are composed of extremely minute particles (atoms) which are indestructible and indivisible *in chemical changes*. The law of Gay-Lussac (1805), that there is a simple relation between the *volumes* of the interacting gases, led Avogadro to his celebrated hypothesis, which is based on a clear distinction between the molecule and the atom. The molecules of elementary gases are not necessarily the atoms themselves, but may consist of clusters of atoms moving about as though they were single particles.

The imagination is almost overwhelmed when we attempt to visualise the enormous numbers of atoms or molecules which are present in even a small amount of material substance. But we recall the story in the Arabian Nights Entertainment—" And then another locust came and carried off another grain of corn "—and we may then appreciate better the almost illimitable number of natural objects and processes.

The atomicity of electricity foreshadowed in Faraday's work on electrolysis was brilliantly established by the measurements of J. J. Thomson, who determined the charge of the electron, the fundamental unit of negative electricity.

Integral relations obtained by Millikan in his experiments on the motion of small electrified particles have furnished indisputable evidence of the atomic nature of electricity. Speaking of the beauty and precision of these results, he says: "No more exact or more consistent multiple relationship is found in the data which chemists have amassed on the combining powers of the elements, and on which the atomic theory of matter rests, than is found in the foregoing numbers." An electric charge wherever it is found consists of an exact number of specks of electricity (electrons) all exactly alike. Thus is confirmed the view suggested by Faraday that "the atoms of bodies which are equivalent to each other in their ordinary chemical action have equal quantities of electricity naturally associated with them."

The atomic number of an element represents not only the number of extra-nuclear or planetary electrons, but also the resultant positive charge of the nucleus itself.

We recall the fact that in 1815 Prout emphasised the nearly integral values of the atomic weights of a number of elements, and suggested that all the elements were built up of one common material, hydrogen. The atom of any other element he supposed to be an extremely stable combination of hydrogen atoms. This suggestion led to a close examination of atomic weights, but after a series of accurate experiments, Stas still obtained fractional values for certain elements, and was led to characterise Prout's hypothesis as "an illusion, a mere speculation definitely contradicted by experience." Within recent years the position has been completely changed through the discovery of the existence of isotopes, that is, substances differing in atomic weight, but having identical chemical properties. This discovery makes it possible to explain fractional atomic weights as arising from the existence of two or more isotopes, and thus justifies a revival of Prout's hypothesis.

Direct evidence in favour of the idea that an atom of, say, nitrogen is composed of hydrogen atoms is afforded by the experiments of Rutherford on the disintegration of the nitrogen nucleus by bombardment with a swiftly moving alpha particle. Again, the marvellous experiments of Aston, using his mass-spectrograph, have shown that a whole number may be applied to the relative *masses* of the majority of the elements when oxygen ($O = 16$) is selected as a standard. The masses of the atoms of almost all the elements measured may then be expressed as whole numbers to an accuracy of about one part in a thousand. This clearly suggests a return to Prout's hypothesis that the atoms of the elements are different aggregations of atoms of hydrogen. The modern statement of the hypothesis would be: "the atoms of the elements are aggregations of electrons and protons"—the proton being the positively charged part remaining when an electron is detached from a neutral hydrogen atom.

The Rutherford-Bohr Atom.

The dynamic model of the atom suggested by Rutherford (1911) and developed by Bohr (1913) may be termed an astronomical atom, as the motion of the electrons round the massive nucleus may be compared to the motion of the planets round the sun. The similarity arises from the fact that the force of electrical attraction between electron and nucleus obeys the same law as the Newtonian law of gravitation and is inversely proportional to the square of the distance between the bodies concerned.

Newton was the first to prove that the law of force, now familiar as the *inverse square law*, gives an elliptic orbit as required by Kepler's first law.

Kepler's second law of the constancy in the rate of description of radial areas means that the moment of momentum, or the angular momentum, of the particle about the origin is constant throughout the motion.

Let us consider an atom in which electrons are revolving about a nucleus and are subject to the force of electric attraction towards the nucleus, and for the time being let us neglect the mutual influence of the electrons upon one another. Then each electron must have a constant moment of momentum characteristic of its particular orbit.

In Bohr's first statement of his theory he dealt

with the problem of a single electron revolving round a massive nucleus, as in the neutral hydrogen atom. He employed the quantum condition of Nicholson, and in this way fixed the angular momentum of the electron, putting it equal to a multiple of $h/2\pi$. The electron can then revolve only in certain selected or 'permitted' orbits which are allowed by the quantum relation.

The simplest illustration of the application of the quantum condition is afforded by the circular orbits of the hydrogen atom. The innermost orbit corresponds to the normal state of the atom. But it is possible, according to Bohr's original presentation of his theory, for the electron to move in other stable orbits, and it is found that the radii of successive orbits increase as the squares of whole numbers, that is to say, as 1, 4, 9, 16, 25 . . ., and so on. The energy associated with a particular orbit varies inversely as the diameter of the orbit, and consequently inversely as the square of the corresponding 'quantum number.' The series of states thus suggested may be regarded as a set of energy levels. Bohr supposes that it is possible for an electron to 'jump' in some way not described from one such level to another and in so doing to emit or absorb radiation. When the electron falls from an outer orbit to the innermost orbit, a line of the Lyman series is emitted. If, however, the final orbit is the second from the centre, a line of the Balmer series is emitted. The Paschen series is produced when the electron passes into the third orbit.

In the later developments of the theory by Wilson and Sommerfeld, elliptic orbits were considered and it was found possible to give an explanation of the fine structure of the lines of hydrogen and ionised helium. In the discussion of the 'stationary states' of the dynamical system, certain quantum restrictions have to be imposed so as to determine the 'permitted' orbits. These quantum conditions may be expressed by saying that the integrals of action during a complete period must be a multiple of the constant h.

The Quantum Postulates.

The older quantum theory was based by Bohr upon certain fundamental postulates which represent a definite departure from the results obtained by considering a system of particles satisfying the laws of classical dynamics. The first postulate affirms the existence of 'stationary' states in which, contrary to the principles of Maxwell's electromagnetic theory, no radiation is either emitted or absorbed. The second postulate is contained in Bohr's frequency relation :

$$\pm h\nu = E' - E'',$$

which affirms that in the transition between two stationary states one quantum of monochromatic radiation is either emitted or absorbed. Here again appears a striking departure from classical theory, and even a departure from accepted ideas as to causality. For it looks as if the kind of radiation emitted depends not only on the state of affairs before the emission takes place, but also on the state after the emission has occurred.

Bohr's suggestion of 1913 that an electron attached to an atom could emit light only by making a discontinuous jump from one possible orbit to another, quite distinct, orbit has provoked much speculation. To explain this puzzling behaviour it has been suggested that the electron may have some freedom of choice, so that it is impossible to predict to which possible orbit the transition will take place.

In my opinion such a revolutionary hypothesis is not demanded either by the facts or by the model. It is better to regard the atomic model as imperfect in its original form, and to suppose with E. T. Whittaker that sufficient attention has not been paid to the happening at the place to which the jump occurs. Whittaker pictures two coincident electrons, one positive and one negative, at this place ; the opposite charges annul one another and are without effect in the initial state of the system. Emission of radiation is brought about by some external agency which stimulates the discharge of a condenser composed of the excited outer electron and one of these two charges. The other charge is left surviving alone at the end of the process, which is accordingly equivalent to Bohr's notion of a translation of the outer electron to an inner orbit.

In a very interesting essay on the future of physics, L. L. Whyte has laid stress on the assumption of *reversibility* implicit in Newton's laws, which, he claims, is valid neither for atom nor for organism. If it were once admitted that any elementary process were irreversible, it would be necessary to give up the whole system of Newtonian conceptions, which are unsuitable for the treatment of irreversible effects. In his suggestive volume "Archimedes" the issue is formulated thus :

"Is there a real temporal process in Nature? Is the passage of irreversible time a necessary element in any view of the structure of Nature? Or, alternatively, is the subjective experience of time a mere illusion in the mind which cannot be

given objective expression? These are not metaphysical questions that can still be neglected by science with impunity. . . . Moreover, the above questions may be put into precise scientific form by asking if the causal relations which are studied by science are symmetrical and reversible so that we cannot obtain from them any criterion by which to distinguish past and future. If, on the other hand, they are asymmetrical and irreversible, the laws of Nature lead us on necessarily from what went before to what comes afterwards."

If Born is correct in asserting that all quantum processes are irreversible, the philosophical implications are of the utmost importance.

In classical dynamics a knowledge of the position and velocity of all the particles composing a system determines the future motion of the system, and that completely. Thus, when the state of the system is known at a particular instant, it is possible (theoretically) to foretell the state of that system at any later instant.

Laplace visualised this possibility in a famous passage:

"A mind to which were given for a single instant all the forces of Nature, and the mutual positions of all its masses, if it were otherwise powerful enough to subject these problems to analysis, could grasp, with a single formula, the motions of the largest masses as well as of the smallest atoms; nothing would be uncertain for it; the future and the past would lie revealed before its eyes" ("Essai philosophique sur les probabilités," 1840).

This expresses the meaning of the principle of causality on the basis of the older dynamical theory. The idea of knowing exactly the state of a system at some given moment is never realised in practice, and consequently the introduction of considerations of probability is justified and statistical methods were frequently employed.[2]

Matrix Mechanics.

Heisenberg put forward the demand that only such quantities as are observable should be represented in the mathematical formulation of atomic theory. The selected orbits of the older theory cannot be directly observed and cannot, even ideally, be subjected to measurement. On the other hand, the frequencies and intensities of the light emitted, scattered, or absorbed by an atom can be both observed and measured. This led to the development of the matrix mechanics, every term in a matrix corresponding to something which is, at least ideally, observable. The dynamics of matrices may be regarded as a generalisation of classical dynamics, the latter being the limit of the former. Instead of the quantum conditions of the earlier theory, the quantum constant h is now introduced in an equation expressing the fact that the rule of multiplication in the new mechanics is non-commutative. In fact, if p and q are conjugate canonical variables, we have $pq - qp = h/(2\pi i)$. This is known as Heisenberg's uncertainty relation.[3]

There is a further point of difference between classical mechanics and the more recent quantum theory, which has been emphasised by Heisenberg. In the older theory the position of a particle can be definitely fixed at a specified moment by means of its co-ordinates. As the time varies it is supposed to be possible to follow the track of the particle through space, or to determine its 'world-line' in the four-dimensional world. In the new quantum theory both the position and the path of a particle become vague. It is argued that the position or trajectory of an electron can only be determined by illuminating the electron by a beam of light, and this illumination itself will interact with the electron, rendering the exact measurement of position or path impossible. There is an element of uncertainty in the proposed determination, the amount being specified by Heisenberg's 'uncertainty relation.'

This relation involves the positional co-ordinate q, and also the momentum (impulse co-ordinate) p, and may be interpreted by saying that when we try to determine exactly where the electron is—and to do this we have to use a beam of light—it behaves in such a way that we are unable to measure simultaneously its exact velocity.

Wave Mechanics.

Louis de Broglie threw fresh light on the difficulties which had become so serious in quantum theory, in a series of papers in which a material particle was regarded as closely associated with a group of waves having velocity and wave-length governed by the speed and mass of the particle. Every such particle when at rest is the centre of a pulsation extending throughout space. This means that the 'particle' is to be treated as a singularity of a pulsation which at any given time is in the same phase through space. We may consider these pulsations throughout boundless space as in some respects analogous to standing waves along

[2] See an article by H. F. Biggs (NATURE, Vol. 121, p. 503; 1928).

[3] The occurrence of the imaginary quantity $i = \sqrt{-1}$ in this equation is remarkable, and may be significant. Written in the form $ipq - iqp = h/2\pi$, the relation suggests that the fundamental phenomenon in microscopic processes is gyroscopic in nature.

a finite string or in an organ pipe. Another imperfect analogy may be found in the vibrations of a bell or Chladni's plate.

When the 'particle' is moving with reference to the observer with uniform velocity, the pulsations will no longer be simultaneous but will be represented by travelling waves.

"The 'region occupied by the particle' is the region where a set of these waves, varying continuously in direction and in frequency over a small range, reinforce each other to form a *wave-group* travelling with what we call 'the velocity of the particle.'"

The velocity of a particle thus appears as a *group velocity*. The consequences of this theory, as developed by Schrödinger and others, have been tested by their application to problems of spectroscopy and by more direct evidence derived from experiments on the reflection of electrons from crystals (Davisson) and on the patterns formed by the passage of cathode rays through very thin films (G. P. Thomson). These patterns are similar to those obtained with X-rays in the 'powder' method and agree in dimensions with the predictions of wave mechanics.

An interesting, though somewhat problematical, application of the ideas of de Broglie accounts for the integral relations in Bohr's circular orbits. By imagining a ray of the waves to travel round the circular orbit, and introducing the condition that the circumference contains a whole number of wave-lengths, the angular momentum of the electron is restricted to the values previously assigned. In this connexion it is interesting to recall the views of Sutherland (1901) with regard to the origin of lines in spectral series. He came to the conclusion that the series must arise from kinematical considerations, and explained them by considering the nodal subdivisions of a circle. A similar idea was put forward in the Physical Society discussion on the ring electron in 1918.

Views analogous to those of de Broglie have been published by J. J. Thomson in a lecture entitled "Beyond the Electron" (1928). The electron "has a dual structure, one part of this structure, that where the energy is located, being built up of a number of lines of electric force, while the other part is a train of waves in resonance with the electron and which determine the path along which it travels." This view is very similar to the view of the structure of light suggested by J. J. Thomson in 1924. "This duality is a necessary consequence of the transmission of energy through the ether by waves: for this involves two things, the transmission of energy and the propagation of the waves." The transmission of energy takes place with the 'group' velocity, the transmission of waves with the 'wave' velocity. "If we concentrate on the waves we have an undulatory theory; if on the energy a corpuscular one."

The most promising attempt yet made to *explain* quantum phenomena and the existence of quantum numbers is undoubtedly that of Schrödinger in his undulatory mechanics. We have here the nearest approach to classical principles in the formulation of the wave equation and in the suggested interpretation of the wave function ψ.

As pointed out long ago by Hamilton, there is a close analogy between mechanics and optics; in fact, his theory of mechanics grew out of his "Optics of Non-homogeneous Media." Classical mechanics is analogous to geometrical optics. The motion of a material system may be studied by considering the path of a mass-point in configuration space, that is, the space of the variables which are *positional* co-ordinates. To the path of this representative point in configuration space there corresponds the path of a ray of light in geometrical optics. But we know that geometrical optics fails to account for the facts and must be replaced by undulatory optics as soon as the obstacles or apertures are no longer great compared with the wave-length. We also know that in the atomic domain classical mechanics fails, the failure becoming evident when the curvature of the path becomes very great. This suggests that we really require an undulatory mechanics which may be regarded as the Hamiltonian analogy of undulatory optics. Wave mechanics bears to ordinary mechanics the same relation as undulatory optics bears to geometrical optics.

It has been said in picturesque language that according to Schrödinger: "Nature is not made up of electrons but of waves. The atom must be considered as a system of electric waves spread over its whole volume. 'Electrons' are merely an inaccurate way of describing some of the properties of these waves" (L. L. Whyte).

It is important to remember, however, that Schrödinger's waves are not waves in ordinary space, but waves in 'configuration space,' which has as many dimensions as there are degrees of freedom of the system. Disregarding rotation, this would be $3N$ for a system composed of N particles. It is only in dealing with the one-electron problem that we are able to use space of three dimensions.

In macro-mechanical problems classical dynamics

may be employed. In micro-mechanical motions the equations of the old dynamics are no longer valid; they must be replaced by a *wave-equation* in configuration space. This equation contains a parameter E, which corresponds to the mechanical energy in macroscopic problems. It is only for certain special values of E, the *proper values*, that the wave equation possesses solutions which (together with their derivatives) are one-valued, finite and continuous throughout configuration space. These proper values include the 'energy levels' of the older quantum theory, the quantum numbers arising in a straightforward way out of the wave-equation. Thus in Schrödinger's undulatory mechanics "quantum numbers are accounted for in a perfectly natural way, practically on classical principles," or, as de Broglie has expressed it: "The appearance of integers in the dynamical formulæ ceases to be mysterious, and becomes as natural as their occurrence in the theory of vibrating strings or of wireless antennæ."

The integral relations thus obtained represent one of the triumphs of the new theory, and it is found that when the energy levels thus determined are not in exact agreement with those previously deduced, the deviations are all actually in favour of the new mechanics. It is especially noteworthy that the results of Heisenberg's quantum mechanics agree with those of the undulatory mechanics, where there is a difference from the old quantum theory. As Schrödinger points out, this is the more remarkable, as the whole mathematical apparatus seems fundamentally different in the two methods.

Dirac has developed an even more general method of treatment, which may be called a quantum algebra. For the representation of atomic quantities he introduces quantum variables or quantum numbers (q-numbers). These are subject to the ordinary arithmetical laws, with the exception that they do not obey the commutative law of multiplication. By employing certain additional hypotheses, Dirac is able to express the mechanical laws in Hamiltonian form. Born and Wiener have suggested that quantum magnitudes may be considered as functional operators, an idea that would account for the failure of the commutative law, since the successive application of two *operations* may depend on the order in which they are carried out. A further point of interest to the mathematician is the analogy between the theory of matrices and that of integral equations (Lanczos).

The New Outlook.

We may summarise the chief results of this recent work as follows. In classical theory we have been accustomed to deal with point events and with the movement of mass particles. Now the picture becomes blurred, or at least less sharp and clear. No longer are we to consider a mathematical point in three-dimensional space, but instead a small region in the space-time world. The concept of a massive particle of infinitesimal size is to be replaced by the idea of a focus of waves. For the path of a particle, which corresponds to a ray in geometrical optics, must be substituted the track of a group of waves as in physical optics. In spite of these differences in outlook, we are assured by Bohr that we have to deal not with *contradictory* but with *complementary* pictures.

The older or classical quantum theory is based on stationary states and quantum jumps. Schrödinger endeavoured to retain so far as possible classical conceptions, in which there are no discontinuities. Thus there has arisen a difference in outlook between Schrödinger and other workers in this field. For example, Born and Jordan hold that Schrödinger's relations have to be interpreted in a statistical sense. According to Schrödinger, quantum mechanical laws can be expressed by quite ordinary differential equations; according to Born, the reason why it is possible "to represent anything in the discontinuous confusion of quantised atomic processes by differential equations, is that the function which is to satisfy the differential equation is a probability."

Jordan (Nature, vol. 119, p. 568; 1927) sums up this position in the following words: "Classical physics described the world in terms of quantities continuously propagated in space and time. The quantum theory describes the world in terms of an abstract, many-dimensional configuration space, and the number of dimensions is proportional to the total number of particles in the world. In this abstract space we have again the propagation of continuous quantities; but these no longer tell us directly about the single atomic phenomena, but rather about the probabilities of the quantum processes. Determinism—not as a metaphysical distinction from chance, but in the physical sense explained above—has the same formal validity in both theories."

Jordan concludes his review of the philosophical problem by saying: "Probably we shall find that an incomplete determinism, a certain element of pure chance, is intrinsic in these elementary physical laws."

Earlier in this address, emphasis was laid on the requirement that light should possess a certain structure so as to afford points of concentration of radiant energy—a requirement which is difficult to reconcile with the undulatory theory. On the other hand, it now appears necessary to introduce into the classical picture of material particles some of the characteristics of wave motion. Is it possible to combine these two problems into one and effect a synthesis between a corpuscular and a wave theory both for radiation and for matter? This question has been discussed by de Broglie, who suggests that the exact description of the phenomena can only be given through the consideration of waves *which admit of singularities*. In his view the material particle is an essential reality, and its motion is completely determined as that of a singularity in the amplitude of a wave which is propagated.

"It would in this way be possible to retain the atomic structure of matter and of radiation, as

well as the determinism of individual phenomena, while at the same time attributing to the continuous solutions the statistical meaning which Born and implicitly Schrödinger have recognised in them."

Bohr has discussed the significance of recent developments in the quantum theory in an important, though difficult, paper published last April (NATURE, Vol. 121, p. 580). The quantum postulate "attributes to any atomic process an essential discontinuity, or rather individuality, completely foreign to the classical theories, and symbolised by Planck's quantum of action." Bohr believes that the causal space-time description of phenomena to which we are accustomed in dealing with macroscopic phenomena may fail us when we have to do with atomic (microscopic) phenomena. This failure arises from the small value of the quantum of action as compared with the actions involved in ordinary sense perceptions. The situation is illustrated by considering the question of the measurement of the co-ordinates of a particle, taking into account Heisenberg's relation between them. This relation implies a certain maximum precision with which the space-time co-ordinates and momentum-energy components of a particle can be measured simultaneously.

At the outset we compared the corpuscular theory and the wave theory to two separate buildings. Perhaps Bohr's latest work may be regarded as an attempt to dig an underground passage between the two, but the tunnel is dark and gloomy, and the atmosphere scarcely fit for human respiration. We might wish to find another solution like that proposed by the philosopher Alice in "Through the Looking-Glass":

"She went on and on, a long way, but wherever the road divided there were sure to be two finger-posts pointing the same way, one marked 'TO TWEEDLEDUM'S HOUSE,' and the other, 'TO THE HOUSE OF TWEEDLEDEE.' 'I do believe,' said Alice at last, 'that they live in the same house! I wonder I never thought of that before.'"

But Alice never found the house, and when she met the two little men, conversation proved difficult.

"I know what you're thinking about," said Tweedledum; "but it isn't so, nohow."

"Contrariwise," continued Tweedledee, "if it was so, it might be; and if it were so, it would be; but as it isn't, it ain't. That's logic."

We had better abandon the simile of the house and try another analogy. We may liken the 'complementary' theory of Bohr to a see-saw on which Tom Particle and Mary Wave are so evenly balanced that a touch will send one end of the plank up or down. If we attempt to fix one end to mother earth, the other is suspended in mid-air. But fixity is not one of the essentials of a see-saw, and however much we may desire a firm foundation for a scientific theory, it is at least possible that fixity is not attainable by finite human intelligence. Bohr concludes his article by pointing out that in the scientific situation there is a deep-going analogy to the general difficulty in the formation of human ideas, inherent in the distinction between subject and object.

In philosophy, as in science, it is generally admitted that there has been a movement away from the mechanical view of Nature which dominated the nineteenth century. The new movement, as expressed, for example, in the writings of A. N. Whitehead, is towards "the recognition of purposiveness and creativeness in Nature." It is difficult to understand all the implications of Whitehead's work, but in his view, as in that of Bergson, the basic idea of *process* must be employed in building up a scientific philosophy. In the organic theory of Nature we have to consider, not a bit of material as in the materialistic theory, but a complete *organism*. In the physical field the primary organisms appear to be vibratory entities, and a proton or electron may perhaps be regarded as a vibrating pattern—a view not very different from that of Schrödinger. "The path in space of such a vibratory entity—where the entity is constituted by the vibrations—must be represented by a series of detached positions in space." Thus it will be seen that Whitehead's views are in harmony with the ideas of the quantum theory, although it is as yet too early to regard that theory as entirely comprehensible.

What, then, is the conclusion of the whole matter? Biologists, chemists, engineers, and also philosophers, are looking to the physicist to give a clear pronouncement as to the nature of fundamental physical processes. At the present moment no clear unambiguous reply is possible. We are still at the stage in which exploration of scientific facts is needed, and, on the other hand, candid examination of the basic ideas in philosophy is required. One lesson at least is emphasised by the recent history of scientific thought, and that is the necessity for caution and modesty in our approach to these fundamental conceptions. We often find discarded theories re-born, and we may learn even from the mistakes of the leaders in science.

Truth, in the realm of physical science, is no longer enshrined in a pellucid crystal sphere. Rather it is to be found in a quivering, pulsating orb of fire. The rainbow colours change as we gaze upon it, and from time to time dark clouds obscure our view. In the search for truth the mental philosopher and the natural philosopher must join forces; and the quest is worth while: "For wisdom is more mobile than any motion. Yea, she pervadeth and penetrateth all things by reason of her pureness. For she is an effulgence from everlasting light."

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Recently, however, an ore was found, accompanied by slag, at Jabal al Ma'adan in Wadi Ahin, inland from Sohar, in the State of Oman, which proved to contain nickel. It was found only in the form of thin veins, much mixed with other minerals. The percentage of copper was small, but that of nickel relatively to the copper was very high. The figures were copper 1·0, nickel 0·19. The slags contained 1·50 and 4·30 per cent of copper and no nickel, which is in accordance with probable smelting practice.

The Committee has thus achieved a tangible and encouraging result, though it would be going beyond the evidence at the moment to suggest that it is conclusive. Mr. H. Peake, however, in a communication presented to the recent Orientalist Congress at Oxford, suggested that Jabal al Ma'adan might be the site of Magan, referred to by Sargon in his geographical tablet and mentioned in the time of Judea in the lists as one of the places from which came ships and copper.

On the other hand, Prof. Desch mentions an ancient bronze object from the Transvaal which contains so much as 3 per cent of nickel. He thinks that as the copper ore, which is malachite in a quartz gangue, is accompanied by a green nickel arsenate, anabergite, this might have been mistaken for malachite, thus explaining the presence of nickel. This is suggestive, for it is known that farther to the north in the Belgian area nickel blooms have been used. Although vast quantities of metal have been taken from the Transvaal and Katanga area, the age of these workings is quite unknown. It certainly should be investigated. Another research committee of the British Association has this question under consideration, but is unable to continue its investigations owing to lack of adequate funds.

Obituary.

PROF. R. A. BERRY.

HE sudden death of Reginald Arthur Berry, which took place in Glasgow on Oct. 12, at the y age of fifty-two years, deprives Scotland of one ts most active workers in agricultural science. ry was educated at Oundle and at Cambridge. er acting as assistant for several years to the Prof. Liveing, he transferred in 1900 to the ool of Agriculture at Cambridge. There he ked with Prof. T. B. Wood for the next five rs, and, in collaboration with him, published ie valuable papers; in particular their investiga- into the composition of root crops has always n regarded as a fundamental piece of work.

n 1905, Berry was appointed professor of agri- tural chemistry in the West of Scotland College Agriculture at Glasgow. Here his teaching duties re heavy, and his laboratory accommodation agre and inconvenient; notwithstanding these iculties he steadily carried on his work, and the number of papers published during the last nty-three years bears evidence to his zeal and his wide interest in the various divisions of icultural chemistry. An investigation into the nposition of oats was followed by a large number papers dealing with feeding problems and with ious aspects of dairying; he did much work on utilisation of the by-products of the dairy lustry, and, at the last meeting of the British sociation in Glasgow, presented, in conjunction Mr. A. Macneilage, the results of an inquiry nuch economic importance into the utilisation surplus milk. Berry was also much interested took a share in the development of the modern hods of soil surveying which have been adopted Great Britain; he was an active member of the ntific Advisory Committee to the Royal and nt Golf Club.

married the elder daughter of the late Mr. mith, of Doonfoot, Ayrshire, and is survived his widow and two daughters. He had a wide le of friends, by whom his memory will ever be in affectionate remembrance.

MR. S. R. PIKE.

THE death occurred on Nov. 22, in hospital at Pasadena, California, of Sydney Royston Pike. Mr. Pike was born in 1903, and showed a marked bent towards astronomy from early years. He entered Balliol from Bedford School in 1920 with a scholarship awarded for distinction in that subject. Graduating with a first class in physics in 1924, and following this up by a year's research in Oxford, he was appointed assistant lecturer in physics in the University of Leeds in 1925, and soon showed his originality by a series of papers on astrophysical subjects. During the present year, having been awarded a research fellowship by the International Education Board, and granted a year's leave of absence by the University, he proceeded to Mt. Wilson in September, and had scarcely begun work when symptoms of meningitis, following a severe chill, necessitated his removal to hospital.

In letters Mr. Pike had remarked on the universal kindness with which he had been received by his new friends in California. To all of them his relatives and English colleagues wish to express their deepest gratitude. They also wish to record their high appreciation of the generous action of the American authorities under whose auspices Mr. Pike was working, in according him a last resting-place near the great observatory in which his labours were so prematurely cut short.

WE regret to announce the following deaths:

Prof. T. C. Chamberlin, emeritus professor of geology in the University of Chicago, the Nestor of American geologists, who was a foreign member of the Geological Society of London, on Nov. 15, aged eighty-five years.

Dr. V. E. Emmel, professor of anatomy in the college of medicine of the University of Illinois, on Nov. 8, aged fifty years.

Prof. Franz Stuhlmann, formerly general secretary of the Hamburg Colonial Institute and one of the pioneers in the opening-up of German East Africa, who accompanied Emin Pasha in his last expedition in 1894, aged sixty-five years.

News and Views.

PRESENT-DAY physics is in a state of flux. Rival theories have been advanced with startling rapidity to explain the ultimate structure of the atom—in so far as such an explanation may ever be possible. In their present state, such theories are of a professedly mathematical complexion and unfitted for universal consumption; some old conceptions are being discarded and others are being resuscitated. In a supplement to our issue this week, Prof. H. S. Allen gives a sketch of the rise of the quantum theory and in general terms its present position. To many who desire a clear statement of the case, such a summary will be interesting, but in a measure disappointing. As Prof. Allen points out, the position is as yet by no means cleared up. Are we to regard light as corpuscular or undulatory, or both? Has the electron an objective existence? Are the ultimate processes of Nature reversible or not? These are some of the questions to which an answer is eagerly awaited. We are in the position of a man standing before a locked safe which contains the answers to all the riddles of the universe. Around him are uncountable stacks of keys. By patient trial he has found some which nearly fit the lock. Perhaps the right key is among those which he has chosen and the non-success of his efforts to open the safe is due to faulty manipulation of the key. Perhaps, after all, the right key has yet to be tried.

THE situation in physics is certainly promising. It must be borne in mind that the application of mathematics to actual phenomena is of a two-fold nature. A suitable mathematical clothing has to be found. The rules of mathematical reasoning are applied to the symbols used, and equations are deduced or numbers calculated. This is the province of mathematics proper. The crux arises when these results are to be interpreted in connexion with the events to which they are to be related. The physicist points a finger and demands 'What does this mean?' And the answer given is not always to his liking. Possibly the interpretation is unsuitable, possibly it appears to contradict notions long established, or possibly the clothing is a misfit. The quantum theory has appeared in strange garbs, but the fact that they are mathematically reconcilable seems to rule out the last possibility and leaves us hopefully expectant of what the future may bring forth.

ONE of the professed objects of the British Science Guild, founded twenty-three years ago by the late Sir Norman Lockyer, is to educate public opinion by spreading the knowledge of scientific achievements and the results of scientific contemplation. With the view of furthering this particular aim, there was recently instituted the Norman Lockyer Lecture, and the fourth of this annual series was delivered in London on Nov. 28 by Prof. J. Arthur Thomson, of the University of Aberdeen. The subject of the address, "The Cultural Value of Natural History," touches a theme upon which natural historians have been too reticent, for the tendency in recent years has been to lay stress upon the economic and practical aspects, and to allow to drift into the background the mental and spiritual aspects, which perhaps appeal more strongly to the man of general education. It is clear, from Prof. Thomson's analysis, that the knowledge and study of living things, not necessarily in a profound, but in a contemplative fashion, possesses a cultural value which cannot be altogether matched by any other branch of knowledge.

IN neat phrases and with a wealth of example, taken largely from recent investigations, the seven contributions of natural history to human culture were driven home by Prof. Arthur Thomson. Power is added to our vision of the world—"the eye sees what it brings with it the power of seeing; and well-informed vision is richest and clearest." The æsthetic sense is cultivated—"there is no risk of the cold light of science hurting the æsthetic emotion, for the more we know of a beautiful thing the greater is our enjoyment." Interest is stimulated—"natural history gives us glimpses of a dramatic world." Big ideas, such as evolution and the interrelations of living things, of world-wide significance, are its progeny. Its problems present infinite variety of mental discipline and resolute thinking; and the deep impressions made by even superficial contact with Nature are of fundamental value in moulding outlook. Finally, there is guidance in human affairs to be found in a rational study of animate Nature—"a society that dispenses with sifting is working its own doom"; "success attends the small families among animals well-equipped in body and mind"; "in bygone days we heard much about original sin, we need to hear more about original righteousness," and so on. This interesting address has been printed by the British Science Guild and may be obtained from the offices, 6 John Street, Adelphi, W.C.2 (Price 1*s*.). The Guild requires financial support to enable it to carry on and extend its useful work for the public good, and we heartily endorse its appeal for new members.

IN a progress report submitted by the Distemper Research Committee to the *Field* Distemper Council and the Medical Research Council, Dr. P. P. Laidlaw and Mr. G. W. Dunkin describe the present position of the research work carried out since 1923 on canine distemper and the various steps by which the results obtained have been achieved; an account of this work was given in the *Times* of Nov. 29. The investigation has reached the stage at which vaccination against distemper becomes a practical proposition on a large scale, although improvement in methods is certain to occur in the future. The method at present in use, which has been found very successful in the field, consists of a double inoculation. The first is made with a vaccine which is, in fact, the inactivated virus of the disease; the second, ten days later, with an attenuated strain of the living virus; the dose of the latter is about a hundredfold that necessary to infect a dog not previously treated with the vaccine, but it produces no upset, or only a slight disturbance, in the general health. Complete resistance to the disease is thus produced, both to injection of infective material and to exposure to contact with an infected animal.

THAT this work on dog distemper has not yet reached finality is shown by the fact that among other lines of investigation being pursued, two lead to the hope of improvement in the method of protection, and also of throwing light on the nature of virus disease in general as it affects both man and animals. There is a possibility that a potent antiserum may be available in the future: this would act as a curative agent for dogs already suffering from distemper, and also, by combination with living virus, as an agent for producing complete protection with only one inoculation; the serum would prevent the animal from having more than a mild attack of fever, whilst the virus would confer a lasting immunity. Finally, the problem of cultivating the virus outside the body is still being actively pursued. Absence of a suitable method makes the preparation of the vaccine a laborious task: the discovery of such a method would undoubtedly advance enormously our knowledge of the other virus diseases and bring nearer the time when satisfactory methods of prevention and cure would be generally available. We understand that the Wellcome Foundation is undertaking the conversion of the laboratory processes into large-scale production of vaccines suitable for the general inoculation of dogs against distemper.

IT is announced in the *Times* of Nov. 30 that Sir Otto Beit has offered £50,000 to King Edward's Hospital Fund for London for the purchase of radium for use in the hospitals. In a letter to the honorary secretaries of the Fund, Sir Otto Beit refers to the fact that the hospitals of London, speaking generally, are not adequately provided with this method of treatment and that he seeks to remedy this state of affairs. The Distribution Committee of the Fund, assisted if necessary by members of the medical profession co-opted *ad hoc*, will decide upon the proportion and the manner in which the gift shall be applied, but the donor especially desires the Committee to secure that the hospitals thus to be provided on loan with radium should be preferably those in which the cure of disease or the alleviation of suffering is associated with a keen interest in the furtherance of the knowledge "for the relief of man's estate." This gift is one more example of Sir Otto Beit's extraordinary generosity in assisting medical work. Readers of NATURE will not need to be reminded of the institution of the Beit Memorial Fellowships for medical research in 1910, or of the way in which they have been supplemented since. It will be noticed that, in the letter of Sir Otto Beit making the offer of this gift, which, it is needless to say, has been gratefully accepted, no mention is made of the diseases which are to be treated with the new supply of radium. There can be no doubt, however, that a big fraction of it will be used in the treatment of cancer. This whole question has now become a national one, and this generous gift, which is an expression of public confidence in the utility of radium as a therapeutic agent, will assist any national scheme which is launched under ...

THE first reports on the Chilean earthquake of Dec. 1 show that it must have been one of great violence, and it is to be feared that the losses of life and property have been under-estimated. The shock, which occurred between 5 and 7 minutes after midnight, seems to have caused most damage at Talca, a town about 50 miles from the coast. Here, it is said, 85 per cent. of the houses are destroyed, including most of the important buildings. The area of damage is of great size. It extends from Teniente on the north to Chillan on the south, a distance of 200 miles, and it includes Constitucion on the coast due west of Talca. As there is no mention of any sea-waves, it is probable that the epicentre in this case lies on land. From Valdivia and Concepcion northwards, the whole of Chile is subject to violent earthquakes. In the neighbourhood of Talca there are several earthquake-centres, but none of the importance of those that lie near Concepcion to the south, and Valparaiso to the north, of Talca. During the present century there have been two great earthquakes in Chile, the Valparaiso earthquake of Aug. 17, 1906, with its submarine origin between Valparaiso and Coquimbo, and the Coquimbo earthquake of Nov. 10, 1922, with its origin also submarine, and extending northwards from Coquimbo for one or two hundred miles towards Chanaral. The recent earthquake thus points to a migration of the seat of activity several hundred miles to the south.

"MAN'S Mental Aptitudes" is the title of an amusing and significant article by Sir Arthur Keith in the *Rationalist Annual* for 1929. On the assumption that the editors of newspapers publish what people wish to read, he has analysed the space allotted to various interests in the columns of a few papers representative of different classes of readers. In the 'superior' London and northern England papers the results are wonderfully consistent. They indicate that business interests come first in the Englishman's mind, with just one-third of the total space of the 'superior' London daily. Then follow, in descending importance, politics, which Sir Arthur takes as showing the scale of patriotism, intellectuality, sport, artistic and scientific interests, sensational news, and, last, religion. The popular London daily gives the same order, except that sport precedes intellectuality and sensational news precedes art and science. The "most widely read Sunday newspaper," taken to represent the mental fare of 'cottagers,' stands in quite a different category. Here interests are topsy-turvy; sensational news leads with a quarter of the total space, and is followed by sport, intellectuality, business, politics, art, and science. The low percentage of scientific news, from 4 to less than 0·5 per cent. is remarkable, but this and other anomalies may be due to the limitation of the investigation to a few issues, so that a fair average was not available. Some newspapers reserve their special scientific articles for a definite day of the week. Sir Arthur's summing up is a very reasonable conclusion from this original study. "A survey of man's nature, as reflected in the columns of the newspapers he buys and consumes, shows that it is not the intellectual side of his brain which dominates his nature, but the emotional and passionate. Man is essentially an animal of the 'heart' rather than of the 'head,'

and in all our speculations as to his future, this aspect of him must be ever borne in mind."

A WIRELESS beacon installation built at Start Point by Marconi's Wireless Telegraph Co., Ltd., for the Corporation of Trinity House has just been completed. This installation is the seventh of its kind now established round the British coasts. The completion of the Start Point transmitter means that very effective cross bearings can now be taken by ships, for there are now three Channel stations which can be used as fixed points, and they can thus obtain a sequence of bearings and be sure of their position right up the Channel. The transmitter of the type fitted in the British Isles has a power of 500 watts and is operated on a wave-length of 1000 metres, which is the specified wave-length for wireless beacon stations, and the whole equipment is automatically controlled by a master clock for transmitting groups of interrupted continuous wave (I.C.W.) signals at pre-arranged intervals. The call sign of the Start Point station is GSM and accurate direction-finding bearings may be expected up to about 100 nautical miles under normal atmospheric conditions. One of the advantages of the system of position finding in which a wireless beacon station of the Marconi type at a known position is used in conjunction with a direction finder on board ship is that the signals are broadcast in all directions and a direct bearing can therefore be taken on the transmitter from any direction at every signal sent out by it.

IT has been decided that the eighty-eighth annual general meeting and the anniversary dinner of the Chemical Society shall be held in Leeds on Thursday, Mar. 21, 1929. It is the desire of the Council to make this a special occasion for a general gathering of chemists and those associated with chemistry in the north of England, and in order that these meetings may be representative of all branches of chemistry and chemical industry, the local sections of the Society of Public Analysts, the Institute of Chemistry, the Society of Chemical Industry, the Society of Dyers and Colourists, and the Coke Oven Managers' Association are co-operating. The annual general meeting will be held in the University of Leeds on Thursday, Mar. 21, at 4 P.M., and the anniversary dinner will take place in the Town Hall, Leeds, the same evening. The Railway Clearing House has granted facilities by which those attending the meetings will be able to travel from all parts of Great Britain to Leeds at the reduced rate of an ordinary fare and one-third for the double journey.

THE British Boot, Shoe, and Allied Trades Research Association held its first annual president's reception and dinner on Wednesday, Nov. 28, at the Hall of the Worshipful Company of Cutlers, Warwick Lane, E.C.4. Sir William Bragg was the principal guest, while Prof. H. C. H. Carpenter and Mr. A. L. Hetherington attended, representing the Department of Scientific and Industrial Research. In proposing the toast of the Association, Sir William gave an inspiring address, and Prof. Carpenter, as chairman of the Industrial Grant Committee of the D.S.I.R., responding to the toast of the Department, announced the new conditions under which the Department would continue grant aid to the Association. This Research Association was one of the first to be formed, so that much credit is due to the small nucleus of far-seeing boot manufacturers who constituted its initial small membership. Unfortunately, the enthusiasm of the few did not rapidly spread, and although in recent years the membership and influence of the Association have steadily grown, it still remains the smallest industrial research association in Great Britain. This dinner is the first the Association has held, and it is gratifying to find that there are many signs that the footwear industry as a whole is now rapidly awakening to a realisation of the immense possibilities that lie in close co-operation between specialised scientific research and industrial processes.

AT the meeting of the Institute of Fuel on Nov. 21, Lord Melchett delivered a presidential address mainly on the economic condition of the British coal industry. The reorganisation of industry now in progress was likened to the industrial revolution following the introduction of coal and iron. Modern technical advances tend to reduce coal consumption for all purposes, and this, combined with the over-development of world production, has brought about the severe depression and unemployment in Great Britain. In the first place, commercial organisation is essential to avoid the ruinous competition, which ends in the folly of selling at unremunerative prices. The re-establishment of the coal trade necessitates reorganisation of its technology, commercial and labour relations, followed by international agreements with other exporting countries. Internal reorganisation should proceed without delay. That coal is a chemical raw material is now receiving fuller recognition, and a problem which follows naturally is the conversion of coal into oil. This problem will undoubtedly yield an economic solution in the next decade. The direct employment of coal for what it is, namely, a complicated chemical substance, is yet in its infancy. Any revival in the coal trade must have direct and immediate effects on the general prosperity of Britain.

SIR GEORGE SUTTON gave an interesting address on Nov. 7, to the Royal Society of Arts, on "Fifty Years of British Industry." In particular, his remarks on the early days of the cable-making industry and the formation of the Cable Makers' Association (C.M.A.) were very instructive. There is nothing in the appearance of a high-grade cable for carrying heavy electric currents to distinguish it from a low-grade cable. If unregulated competition were allowed, then price would be the sole consideration, and this would rapidly bring about a deterioration of their quality. The leading firms therefore came together and formed an association, primarily for the purpose of adopting standards of dimensions and fixing the quality of the metal and the insulation. These standards are now recognised all over the world. The high factor of safety adopted enabled the cables to carry tremendous overloads during the War. The C.M.A. also extended its activities to regulating [illegible] com-

petition. Going on the assumption that the field was large enough for the growing prosperity of all its members, it formed what is disparagingly known as a 'ring.' However, the C.M.A. has demonstrated that it is possible for a number of firms entirely independent of one another financially to compete in effective service to the consumer and not by ruinous price competition. The research laboratories of the various cable manufacturers now pool their mental and material resources, and the overlapping of researches which formerly took place is largely prevented. The help of the National Physical Laboratory has proved of great value to them. So far as recruits for the industry is concerned, the employers want a combination of higher education with practical experience. Some colleges give this. Of late years there has been a notable increase in the employment of public school boys in industry. Their training fits them admirably in many ways for positions of control.

THE November number of *Naturæ Novitates*, published by R. Friedländer und Sohn, of Berlin, is of special interest as commemorating the fiftieth year of that bibliography and also the centenary of the existence of a firm to whose whole-hearted labours in the publication and distribution of scientific books and periodicals we all owe so much. R. Friedländer opened a bookshop in the Königstrasse in Berlin in 1828. The interest taken by the scientific men of the day soon caused him to confine his attention to scientific literature. At that time the work of Linnæus and others had led to the publication of a great many books on botany and zoology, and these were often expensive and difficult to obtain. Friedländer's first general catalogue of scientific books was issued in April 1836; his seventh catalogue dealt with natural history, and his eighth catalogue, published in 1847, covered the whole field of zoology. The firm began as R. Friedländer, but in 1851, when Dr. Julius Friedländer joined, it became R. Friedländer und Sohn. Julius was proficient in mathematics and physics. His knowledge of these subjects was of great assistance to the firm, which soon began to publish catalogues of scientific books at regular intervals. In 1878 he began the publication of *Naturæ Novitates*, a bibliographical periodical cataloguing scientific works as they appear. On the death of Dr. J. Friedländer in 1882, his former assistants, Ernst Buschbeck and Otto Budy, continued the work. At the present time the heads of the firm are Paul Budy, Dr. Kurt Budy, and J. R. Loewe, who will have the best wishes of all scientific workers for a happy and prosperous new century for the firm of R. Friedländer und Sohn.

THE inaugural series of Riddell Memorial Lectures, endowed anonymously in memory of the late Sir John Walker Buchanan-Riddell, was delivered before the University of Durham, by Prof. C. C. J. Webb, fellow of Oriel College, Oxford, and first Oriel professor of the philosophy of the Christian religion, on Nov. 28, 29, and 30 at Armstrong College, Newcastle-upon-Tyne. The general subject of the lectures was "Religion and the Thought of To-day." Modern European philosophy began with a criticism of a religious experience of a Christian type. Movements emphasising one-sidedly the 'universal' and the 'individual' aspects of reality have been checked by the discovery that the resulting positions were unable to do justice to essential facts of Christian religious experience. The position of religion in social life has changed within the last century and a half; and the attempt to find the religious values *within* instead of *beyond* this world and the civilisation which has been developed within it was characteristic of the nineteenth century and was assisted both by the rise of the idea of evolution and by the disintegration by biblical criticism of a purely authoritative conception of the Christian religion. The War, by inducing a revulsion of feeling as to the sufficiency of civilisation to satisfy the spiritual needs of men, brought about a reaction from the immanentism so marked in the religious thought of the preceding age; the problem of the immediate future is to secure the gains of that immanentism while recognising the need of a genuinely transcendent object of religion. The Christian doctrine of the nature of God affords a hint of a way in which these two aims may be reconciled.

LORD RAYLEIGH has been appointed a trustee of the Beit Memorial Fellowships for Medical Research in succession to the late Lord Haldane, who died on Aug. 19 last.

DELEGATES from forty nations recently attended in Paris an International Conference for the Limitation of Exhibitions, when a convention was signed agreeing to limit the number of general long-period exhibitions which are officially recognised to once in ten years at the least in the same country and once in two years at least in all countries. Special exhibitions confined to one trade or industry are limited less strictly. The convention does not apply to any exhibitions which do not seek official recognition or to sample fairs such as that of Lyons or the British Industries Fair. Great Britain was represented by Sir Edward Crowe, the new Comptroller-General of the Department of Overseas Trade; Mr. J. R. Cahill, of the British Embassy; and Lieut.-Col. Cole, of the Department of Overseas Trade. The delegates were accompanied by Mr. Guy Locock, of the F.B.I.; Mr. R. B. Dunwood, of the Association of British Chambers of Commerce; and by Mr. L. A. de L. Meredith, of the Department of Overseas Trade.

REFERRING to a note in our issue of Nov. 3, p. 707, a correspondent reminds us that Prof. Cossar Ewart discussed the question of the fertility of mules in a letter in NATURE of Nov. 24, 1910, p. 106, pointing out that either the true mulishness of the mother or the maternity of the foal was always in some doubt. Such uncertainty, however, does not seem to apply to the cases mentioned in our recent note.

WE regret that in a paragraph in our issue of Dec. 1, p. 854, on electrical equipment for X-ray apparatus, the name of the author of the paper was wrongly quoted. Mr. L. G. H. Sarsfield, the author of the paper in question, also points out that he preceded his remark on the future use of the induction coi for the highest voltage X-ray work with the qualifyin

remark "it may be"; the current rating of the small portable set mentioned is 10 milliamperes, not 10 microamperes.

THE leading article in last week's NATURE referred to a suggestion by Mr. J. B. S. Haldane that the Cabinet might contain at least one member with scientific knowledge. Mr. W. P. Dreaper reminds us that fifteen years ago, starting from the other end, he suggested that there should be a Science Committee in the House of Commons. As at present constituted, it would perhaps be difficult to form such a committee in the House, but as it has been stated that the time lag of all such changes is nineteen years, Mr. Dreaper hopes that his suggestion may come into effect in the next Parliament.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master to teach mathematics in the Smethwick Junior Technical School—The Director of Education, 215 High Street, Smethwick (Dec. 10). A junior assistant under the Department of Scientific and Industrial Research, for work on plasters and other materials used for impressions and models in dentistry—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Dec. 13). A laboratory assistant in the biology department of King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, 61 Campden Hill Road, W.8 (Dec. 15). A physicist under the Australian Council for Scientific and Industrial Research, to take charge of seismic investigations in connexion with the Imperial Geophysical Experimental Survey—Mr. F. L. McDougall, Australia House, Strand, W.C.2 (Dec. 19). A temporary junior chemist at an Admiralty Inspection Establishment—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Dec. 22). Junior assistants at the National Physical Laboratory, with qualifications in physics, electrical engineering or mechanical engineering—The Director, National Physical Laboratory, Teddington (Dec. 22). An expert in cattle breeding under the Egyptian Government, Ministry of Agriculture—The Royal Egyptian Legation, 75 South Audley Street, W.1 (Jan. 1). A professor of medicine in the University of Hong Kong—The Chief Medical Officer, Ministry of Health, Whitehall, S.W.1 (Jan. 7). Research workers at the Rowett Research Institute on, respectively, the nutrition of poultry and the nutrition of sheep—The Secretary, The Rowett Research Institute, Bucksburn, Aberdeen. A male technical assistant with honours in chemistry or physics, under the Chemical Warfare Research Department—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1.

Our Astronomical Column.

PUBLICATIONS OF BERGEDORF OBSERVATORY.—Bergedorf Observatory deserves the thanks of astronomers for the useful series of reference volumes that it is publishing. The G.F.H. or history of the fixed stars has been proceeding in instalments for several years. But that work does not contain observations made later than 1900; as large numbers of more recent catalogues have now accumulated, two volumes containing references to meridian observations made in the present century have just been published, dealing respectively with north and south declinations. Each volume has about 300 pages. The arrangement of the Durchmusterung is followed. The stars are grouped in degree of declination, the reference number of each star according to the Bonn or Cordoba D.M.; then follow a pair of numbers; the first number is the index denoting a catalogue; 401 catalogues are listed at the end of each volume; the second number is that borne by the star in the catalogue referred to. There are a considerable number of stars not contained in the D.M.; these are given in separate lists, at the end of each degree of declination. Thus the material available for each star is shown at a glance.

Bergedorf has also produced a catalogue of its own, containing 4983 stars observed with the Repsold meridian-circle between the years 1913 and 1926. The classes of stars observed are those in Rumker's Hamburg catalogue that needed re-observation, stars with large proper motion, variable stars, comparison stars for planets or comets, etc.; for example, Barnard's proper-motion star and some of its neighbours were observed in 1919. The catalogue bears the name of Dr. F. Dolberg, who did the whole of the observation at the telescope and a large part of the reductions.

THE TOTAL SOLAR ECLIPSE OF OCT. 22, 1930.—This eclipse has a track across the Pacific Ocean, but there are two islands within the belt of totality: Nurakita in the Ellice group, and Niuafou, some 280 miles south of Samoa. *Popular Astronomy* for October contains an article on Niuafou by Mr. Andrew Thomson, Director of the Apia Observatory. He was one of the observers from the United States of the eclipse of 1919 at Sobral, Brazil. Niuafou is a volcanic island about 3 miles in diameter. Mr. Ramsey, a trader on the island, is quoted as saying that landing would generally be practicable for packing cases of moderate size. There are 1100 inhabitants, and a Catholic mission has been there for many years. It is 8 miles from the central line, and totality will last 83 seconds, the sun's altitude being 52°. The weather statistics for Apia indicate the cloud ratio at 9 A.M. in October as 4·8, this being the same as the average for the whole year. 10 A.M. is about the clearest time of the day at Apia; the local time of mid-eclipse is 9.9 A.M. Some expeditions to Niuafou have already been vaguely planned, but no definite arrangements have yet been made.

Predecessors of this eclipse in the Saros cycle occurred in 1858 and 1912, both being total in Brazil. The first was observed by Liais; a Greenwich expedition went to the second but experienced cloudy weather.

NOVA IN MESSIER 33.—*I. A. U. Circular*, No. 211, announces the detection of a nova in this nebula by Dr. Baade at Bergedorf Observatory. It is 2′ preceding and 8′ south of the nucleus; it is thus comparatively near the centre of the nebula, the diameter of which is about 1°. The magnitude of the nova is 16·0, which on Hubble's value for the distance of the nebula (870,000 light years), gives an absolute magnitude of − 6. Novæ in the spirals have been discovered in considerable numbers, there being 67 in the Andromeda nebula between 1909 and 1926. The discovery of the present nova was presumably effected with the large reflector at Bergedorf, which has proved so efficient in the detection of very faint comets.

Research Items.

Excavations in the Pin Hole Cave, Creswell.—In a paper read before the Royal Anthropological Institute on Nov. 20, Mr. A. Leslie Armstrong described the work proceeding in the large inner chamber of this cave. The total depth of the deposit is 15 feet and consists of an upper and a lower cave-earth. Evidences of casual human occupation occur throughout the upper cave-earth and the dominant culture has been proved to be Upper Aurignacian with considerable Proto-Solutrean elements and some traces of intrusive Magdalenian near the top. Upper Mousterian artefacts of quartzite and flint occur at the extreme base. A recent find of outstanding importance to English archæology is that of an engraved drawing of a masked human figure, executed upon a rib, probably of a reindeer. In general character and technique the figure resembles those of Hornos and Altamira, which are of Aurignacian date. It was found in association with Proto-Solutrean implements and was encrusted with breccia. The present specimen is the first Palæolithic drawing of a human figure to be found in Britain, and, being of a type which is rare even in the rich caves of France and Spain, it is of the greatest scientific interest. The engraving was found beneath stalagmite, 3 feet 6 inches below the floor of the cave, on an ancient occupation level, together with Proto-Solutrean and Aurignacian flint implements, and is therefore attributable to the dawn of cave art. The lower cave-earth contains two definite zones of occupation, the lowest at 12 feet. Implements of quartzite and tools of bone and mammoth ivory occur in both zones, the technique of which is Mousterian. Evidence of submergence of the lower cave-earth on two occasions and of climatic changes are well marked, and the occupation zones are separated by sterile layers of fallen roof slabs.

Birds at Sea.—It is well known that in tropical seas many strong fliers amongst birds, such as frigate-birds, spend the greater part of their life at sea far from land, but it is interesting to learn that even in far northern waters there is also a goodly bird population far from the shore. During a voyage along an unusually far northern route—to Greenland—E. M. Nicholson made several counts over 10 sea miles, at distances about 300 miles from land (*British Birds*, November). They yielded numbers varying from 34 to 170 birds, leaving the impression that the oceanic bird population in about 60° N. lat. ranged from 5 to 10 per square mile. The majority of the birds observed were great shearwaters, fulmar petrels, and, in lesser numbers, terns and puffins.

Variation and Correlation.—Messrs. W. W. Alpatov and A. M. Boschko-Stepanenko have made a study of variation and correlation in certain serial organs of insects, birds, and fishes (*Amer. Naturalist*, Oct. 1928). In the Hemipteran *Pyrrhocoris apterus* the biometrical constants for length of joints in the antennæ were determined. The length of the phalanges was studied in the raven, the goose (*Anser albifrons*), collected on Novaya Zemlya, and in domestic fowls from Central Russia. The fish was *Boreogadus saida* from Barents Sea, which has several dorsal fins. A relation was found between absolute size and variability in fin characters, the larger ones being less variable. The wild birds were also less variable than the domestic ones. Pearson's 'rule of neighbourhood' concerning the intercorrelations of serial organs was found to hold in nearly every case.

Mussel Growth in Submarine Shafts and Tunnels.—An interesting report by Dr. James Ritchie, dealing with this subject, appears in the *Transactions of the Royal Scottish Society of Arts*, vol. 19, 1914–25 (Edinburgh, 1927). In 1919, before erecting the new Electricity Generating Station at Portobello, the Committee of Edinburgh Town Council and its consulting engineers foresaw that difficulties might arise from the accumulation of mussels and other organisms in the large tunnels through which water for condensing purposes was to be conducted from the sea. Dr. Ritchie was then asked to carry out experiments in order to prevent such growth, the research, carried on over a period of two years, resulting in the discovery of a successful method of dealing with the obstruction. Whilst other organisms were liable to accumulate in the tunnels, the mussels only were of considerable importance, and it was shown by preliminary experiments that those certainly could accumulate to such an extent as to interfere in no small degree with the flow of water. The mussels enter in the free-swimming larval stage and settle down when only $\frac{1}{75}$ of an inch long, therefore it is practically impossible to prevent their entry. A way had to be found which killed them when once in the tunnel. Dr. Ritchie has now found a suitable method which consists in sending a reversed current or outflow of heated sea water into the tunnels and shafts at stated intervals, at such a temperature and for such a time that all the young mussels will be killed. A suitable minimum temperature is 110° F., the current to be passed through every four weeks during the spatting season, reckoned from the beginning of March until the end of October. These measures have proved to be very effective and have resulted in the entire clearance of the larger mussels from the tunnel. In practice, the raising of the temperature to such a height has proved to be expensive, therefore the alternative method of raising the temperature to 90° F. for a longer period has been adopted.

Sea-Urchins of the Indian Ocean.—An account of the Regular Echinoids forms the third and concluding part of Prof. R. Koehler's memoir on the Echinoidea of the Indian Museum, Calcutta. This part was, says Prof. Koehler, ready in manuscript in 1922; it bears the date of publication, November 1927, but was not received by us until the end of last October. It describes some 50 species, of which 14 are new, and two of these represent new genera, namely, *Printechinus* in the Temnopleuridæ, and *Prymnechinus* in the Echinidæ. An appendix describes two prosobranchiate gastropods parasitic on some of the Echinoids. They belong to the family Eulimidæ, many members of which are already known to infest various Echinoderms. One of them is a *Mucronalia* which settles on an ambulacrum of a *Stereocidaris* and extends its proboscis through one of the pores for the tube-feet; this gives rise to many anomalies in the structure of the test. The mollusc is readily shaken off the test, leaving little direct trace, and it may be that some abnormal Echinoids, both recent and fossil, which have been described, may have owed their peculiarities to a similar cause. The other parasite, which belongs to the allied genus *Megadenus*, is quite small, and lives on a *Dorocidaris*. It attacks one of the main radioles while the urchin is still young, checks the normal growth of the radiole, and becomes enveloped in a gall-like thickening, usually with an opening through which the spire of

the tiny shell can be seen. This shell is that of a female; but in the same cavity there also lodges a yet smaller male. This then represents a stage on the way to the dwarf rudimentary males already known in the Endoparasitic gastropod *Entocolax*.

'DIE-BACK' OF PLUM TREES A BACTERIAL DISEASE.—For many years growers have noticed the occurrence of stunted shoot growth in plum and cherry trees, with foliage pale in colour which withers or falls prematurely. Such 'die-back' has been described as due in many cases to a fungus *Diaporthe perniciosa*, which has been very fully examined by Miss Cayley (*Ann. Applied Biology*, **10**, No. 2; 1923). Mr. H. Wormald has had a disease of this type under observation amongst the plum trees in the experimental plots at East Malling. Fungus fructifications often appeared upon the dead bark in the diseased region, but Wormald noticed that numerous bacteria were often present at the upper and lower limits of the diseased area. This aroused suspicion that the fungi might be a secondary result, and that the causal agent in producing the disease might be bacterial in nature. Isolation and cultural experiments were therefore carried out with the bacteria, and subsequent inoculation experiments with the cultured organism supply evidence that these bacteria can in many cases produce 'die-back' as the result of their introduction through a wound. These observations are briefly described in the *Gardener's Chronicle* for Nov. 10.

PROPAGATION OF RUBBER PLANTS.—A little while ago, the Right Hon. W. Ormsby Gore placed some very interesting data before the fellows of the Royal Colonial Institute, which are reproduced in *Tropical Life* for November 1928. In the old Botanical Gardens of Ceylon, at Heneratgoda, is a group of rubber trees which have been grown from the original seed brought by Sir Henry Wickham from the Amazon. Amongst them is a famous tree which, over a continuous period of five years, gave an average annual yield of 96 lb. of dry rubber. The average annual yield per tree on an ordinary plantation is about 4 lb. Unfortunately, seedlings from the high yielding tree have not possessed a yielding capacity much above the average, and the only possible method to obtain a plantation of high yield from a single plant with these qualities would appear to be by some method of vegetative propagation. Cuttings do not root successfully, so that bud grafting, now practised for some time in the Dutch plantations of Java and Sumatra, seems worthy of very extensive trial in British rubber-growing plantations. Planting Manual No. 2 of the Rubber Research Institute of Malaya (Kuala Lumpur, 1928), which contains an account of the budding of *Hevea* in modern plantation practice by Dr. Summers, is therefore a very timely publication. Dr. Summers makes it clear that the evidence at present available does not justify a complete abandonment of seedling propagation in favour of the new method. Mr. Ashplant has recently claimed (NATURE, June 30, p. 1018; *Tropical Life*, November 1928) that yield of latex is closely correlated with the diameter of the latex tube as determined under certain specified conditions, and states that by this method a reliable guide to future yield is provided which can be employed upon six-month-old seedlings. If further work should substantiate this claim, it may yet be possible to select seedlings of high yielding trees from the nursery beds and build up a plantation of high average yield from seedlings even more easily than from vegetatively propagated clones.

GOLD COAST SURVEYS.—The annual report of the Survey Department of the Gold Coast for 1927-28 shows that the topographical map is nearly complete from the coast to lat. 7° N. The necessity of concentrating work on boundary surveys delayed topographical work during the year. The western boundary is nearly completed, and the eastern, which is the division between British and French mandated territory in the former Togoland, is making good progress. The new survey school at Accra is growing, and turning out annually a number of competent surveyors.

MAGNETIC MAP OF ENGLAND AND WALES.—The Ordnance Survey has published a layer coloured orographical map of England and Wales on a scale of 1 to 1,000,000 on which the lines of equal magnetic variation are drawn at 15-minute intervals (Southampton: Ordnance Survey. 2*s*.). Their approximate courses in the English Channel and the Irish Sea are also shown. The position of magnetic observatories is also clearly shown, with the value of each station for the year 1927. No other names except those of physical features are given. The map is a fine example of colour printing and clear typography.

GEOLOGY OF THE SALT RANGE.—A first-hand contribution to the geology of the Punjab Salt Range is published by Dr. C. S. Fox in the *Records Geol. Surv. India*, p. 147, 1928. In recent years the hypothesis of a Tertiary age for the salt, and of considerable thrust faulting in the Range itself, have been fashionable; Dr. Fox, however, returns to the view already advocated by Murray Stuart that the Saline series lies beneath beds of Cambrian age, and that the Kohat deposits are probably of the same age. He shows that the Tertiary deposits do not provide any evidence of deserts, or of any period of desiccation. On the other hand, the Cambrian beds suggest a prolonged period of arid conditions over a very wide area during which the salt beds could readily have been formed. Similar beds in Persia—also associated with similar volcanic material—are considered to be of Cambrian age, and to belong to the same climatic province. The anomalous position of the salt marl in the Salt Range can be easily and satisfactorily accounted for by simple solution and isostatic settling, while the foliated character of the Kohat salt is a consequence of flowage under the great pressures accompanying mountain folding.

CLIMATE OF JAVA.—The Royal Meteorological and Magnetical Observatory of Batavia continues its publications on the climate of the Dutch East Indies. In the most recent (*Verhandelingen*, No. 6) Dr. C. Braak deals with the climate of Java and Madura. The volume is in Dutch, with a lengthy summary in English. It includes a number of photographs of cloud forms, and two maps showing the wind direction during the east and west monsoons. After a general account of the winds there follows a description of the climate of certain places that have characteristic features. For other stations the full data will be given in the statistical volumes which have yet to be published. Sumatra was treated in a previous volume, which contained a general account of the rainfall. Java contrasts with Sumatra in having a sharp distinction between the wet and dry season. In east and much of central Java there is a rainless season of several months. In west Java this is marked only in exceptional years. Another peculiarity of east and central Java is the persistence of the föhn winds during the dry season. Night frosts occur in Java at great heights. These are unknown in Sumatra. They occasionally do considerable damage to plantations.

ATMOSPHERIC POLLUTION.—The work of the Meteorological Office Advisory Committee on Atmospheric

Pollution was transferred to the Department of Scientific and Industrial Research last year. That Department is responsible for the thirteenth report on observations of atmospheric pollution, although it deals with observations made in the year ending March 1927, prior to the transfer and reorganisation. The form of the report remains unaltered. It includes among several other studies of more than theoretical interest, an analysis of the deposit of atmospheric impurity at eighty different stations in the British Isles, which reveals the fact that between 1914 and 1927 the percentage of stations falling within the two categories with least deposit out of the four into which the range of pollution is divided, has increased from 15 to 87 per cent. It appears that for carbonaceous matter Newcastle-on-Tyne gives the highest figure, while for sulphates Burnley heads the list. In spite of the general improvement, the small percentage of stations in the class with the largest deposit remain unaltered at the end of the period under review. The general conclusion that appears to emerge from these statistics, and from a more detailed study of the relative proportions of carbonaceous pollution and of that due to sulphates, is that in the industrial regions where impurity is derived largely from factory smoke, any improvement is very small compared with the change in residential districts, where the increasing use of gas fires in place of the open hearth makes itself increasingly felt. The report concludes with a short study of the relationship between the degree of impurity of the air in London and the figure for ultra-violet light derived by Dr. Leonard Hill's acetone blue method. This shows that the amount of ultra-violet light received becomes so sensitive to the degree of impurity over a certain range of the scale for impurity, that the fixing of a standard for what may be regarded as hygienically 'clean' air will probably not prove difficult.

AN ELECTRICAL MODEL OF THE HEART.—Some two years ago, Dr. B. van der Pol suggested that the heart-beat was a biological example of the so-called relaxation oscillations the properties of which he had been studying. This idea has now been developed in detail by him and J. van der Mark in a paper which appears in the supplementary November number of the *Philosophical Magazine*. The mathematical treatment of the electrical circuits used in illustration of the theory is involved, but they are essentially systems in which a decay phenomenon repeats itself, the terms in the equations corresponding to the resistance term for mechanical motions being negative for small amplitudes, instead of positive, as is usually the case. The sinus, the two auricles, and the two ventricles are represented respectively by three flashing neon lamps, which are connected in such a way that the order of discharge is that which occurs in the natural heart; the link between the auricles and ventricles—the bundle of His—is another neon lamp. Electro-cardiograms have been taken from the model, and are similar to those of a natural heart, showing not only the main features of the normal beat, but also, when the appropriate additional stimuli are applied, such phenomena as auricular and ventricular extra-systole, partial and complete heart block, and the refractory period. Of special interest is the reproduction of the biological law of 'all or nothing': a stimulus has either no effect at all, or it causes the complete response. The success of their model has prompted the authors to predict from it a number of new phenomena which might be met with in the natural heart, and they state that by elaborating it in another direction they have arrived at a model of a striated muscle upon which they hope to report later.

DETERMINATION OF CELLULOSE BY OXIDATION WITH CHROMIC ACID.—In the cellulose industries the problem of determining the amount of cellulose in a solution containing no other organic material frequently arises. The method of precipitation of the cellulose followed by direct weighing is tedious, and it is much quicker to effect the quantitative oxidation of the material to carbon dioxide and water by means of a mixture of chromic and sulphuric or phosphoric acids. The latter method is described in detail by Constance Birtwell and B. P. Ridge in the *Journal of the Textile Institute* for October. The use of phosphoric acid instead of sulphuric acid is to be preferred, unless the cellulose content of the solution is very low, in order to avoid the possible formation of sulphur dioxide. Instead of measuring the volume of carbon dioxide formed, the amount of chromic acid used may be determined by titration.

GLYCERIN.—The *Journal of the Society of Chemical Industry* for Oct. 19 contains an interesting account by W. F. Darke and E. Lewis of the methods of manufacture and applications of glycerin and some of its substitutes. The chief sources of glycerin are oils and fats, which on saponification yield glycerin and soap or fatty acids. During the War, glycerin was made in Germany by the fermentation of beet sugar, but this and various synthetic processes that have been suggested are not now employed. In medical and pharmaceutical practice, glycerin is used on account of its softening action on the skin, its solvent properties, and especially because of its antiseptic powers. It destroys bacteria much more rapidly than tissue cells, and should therefore be of great value in surgery. It also forms a constituent of certain infant and invalid foods. The industrial uses of glycerin depend chiefly upon the low freezing point of its aqueous solution and its dehydrating properties, although large quantities are consumed in the explosive, adhesive, and ink industries. Many substances have been proposed as glycerin substitutes, such as magnesium butyrate, but their application is limited. Ethylene glycol is sometimes used in place of glycerin as an anti-freeze medium and as a lacquer solvent, but its production is more costly.

DETERMINATION OF PENTOSANS. — The classic method for the determination of pentosans, due to Tollens, and consisting in distilling the material with hydrochloric acid of density 1·06 and weighing the furfuraldehyde thus formed as phloroglucide, is known to be subject to various sources of error. In the *Rendiconti del Reale Instituto Lombardo di Scienze e Lettere*, Parts 6-10 (1928), Dr. C. Antoniani gives the results of experiments made to ascertain the extent to which the values obtained by this method are influenced by the presence of carbohydrates with a 6-carbon atom basis. In the case of fodder, the effects of hexoses or hexosans are not, as a rule, sufficiently large to invalidate the conclusions drawn from the pentosan content with regard to the value of the fodder. From the purely analytical point of view, such admixtures do, however, exert an influence, this being least for cellulose and appreciably greater for starch and hexoses in general. The discrepancies are due, only in slight degree, to the formation of extra quantities of furfural, and depend mainly on the presence in the distillate of hydroxymethylfurfural, which is derived from the dehydration of the hexoses and is, under the conditions employed, only partially converted into levulinic acid. This hydroxy-compound may be removed by redistillation of the first distillate, but allowance must then be made for the diminution of the furfural originally present by 7 per cent. The experimental results indicate that the furfuraldehyde phloroglucide obtained is not always of exactly the same composition.

Anniversary Meeting of the Royal Society.

THE anniversary meeting of the Royal Society was held on Nov. 30, and in his presidential address Sir Ernest Rutherford referred to the Society's loss by death during the past year of two foreign members, thirteen fellows, and two fellows who were elected under Statute 12, which provides for the election of persons who have rendered conspicuous service to science, or whose election would be of signal benefit to the Society. He also reviewed the work of the three Yarrow and two Foulerton professors who have been appointed since 1923, and announced that the Council has decided to fill the Foulerton chair vacant through the death of Prof. E. H. Starling. Dr. E. D. Adrian, lecturer in physiology in the University of Cambridge, has accordingly been appointed. With the aid of apparatus using electrical amplification, Dr. Adrian has been engaged in recording and analysing the minute changes transmitted, from an excited peripheral sense-organ, along the conducting system of the nerves—changes which, on arrival at a nerve-centre in the brain of a conscious being, would result in one or another form of sensation.

Sir Ernest Rutherford then gave an account of recent work on high frequency radiation, which appears elsewhere in this issue. The presentation of medals followed, and we print below extracts from the descriptions of the work of the medallists.

Presentation of Medals.

THE COPLEY MEDAL, AWARDED TO SIR CHARLES PARSONS.

In the world of mechanical engineering the genius of Charles Parsons has opened up a new era. He has originated and developed a new type of thermal engine entirely flexible and adaptable, and capable of high efficiency combined with concentration of power never even imagined before. By continuous practical effort for the past forty-five years, aided by remarkable mathematical insight acquired in his university days, he has perfected the parallel-flow compound steam turbine, and has applied it successfully to electric generation and to marine propulsion, both attaining to an unprecedented scale. While the utilisation of heat in the best triple-expansion reciprocating steam engine amounts to 17 per cent of the whole, the Parsons' large central station turbines now convert 25 per cent into mechanical power, and in still larger turbines 28 per cent is anticipated. The first steam turbine of 4 kilowatts was used in 1885 for electric lighting; at present, turbines of 20,000 and 30,000 kilowatts are in operation. The application to marine propulsion was signalised in 1897 by the appearance of the *Turbinia*, a small experimental craft developing the extraordinary speed of 33 knots. Large turbine-driven destroyers for the Navy rapidly followed, and now all large high-speed liners are turbine driven. During this remarkable development numerous problems arose involving a precise study of jet velocities, leakage, turbulent flow, and vacuum augmenters. The phenomena involving cavitation of screw propellers opened up new fields of abstract as well as practical interest. Sir Charles Parsons has been greater in the scientific development of thermal power produced by steam than any engineer since James Watt. A recent side product of his activities has been the revival of the British scientific industry of optical glass and telescopic construction, while some of his hours of relaxation have been spent in the strenuous endeavour to crystallise carbon into diamonds by catastrophic processes.

THE RUMFORD MEDAL, AWARDED TO PROF. FRIEDRICH PASCHEN.

Prof. Paschen is especially distinguished for his practical and theoretical contributions to spectroscopy. He early acquired remarkable skill in the investigation of infra-red radiation and made valuable determinations of the distribution of energy in the spectrum of a black body, giving the first experimental proof of the law that the frequency of maximum energy is proportional to the absolute temperature. He afterwards made numerous observations of the infra-red emission spectra of various elements, which were of fundamental importance for the development of our knowledge of series in spectra, and afterwards for the theory of spectra in relation to atomic structure. He has also contributed in a notable degree to the precise measurement and series classification of spectrum lines in general; he has long been one of the foremost workers on the Zeeman effect, and the results which he has obtained, including the discovery of the well-known Paschen-Back effect, have been invaluable for theoretical discussions. He has shown extraordinary skill in the design and manipulation of apparatus, and his work is characterised by an obvious striving for the greatest attainable precision.

A ROYAL MEDAL, AWARDED TO PROF. ARTHUR STANLEY EDDINGTON.

Prof. Eddington's contributions to knowledge within the past ten years have been mainly in connexion with the internal constitution of stars and with the generalised theory of relativity. He has formulated a complete theory of the internal structure of a star, assumed to be a non-rotating whirl of atoms and electrons, with radiation gradually forcing its way to the surface; further, he pointed out that the masses of stars, which are found by observation not to vary greatly, ranged about the point where radiation pressure balances gravitation. Later, he obtained a theoretical relation between the mass and absolute luminosity of giant stars. Prof. Eddington has also worked out a mathematical theory of Cepheid variables on the assumption that they are oscillating radially. In connexion with the theory of relativity, he conducted in 1919 one of the two eclipse expeditions which verified the deflection of light rays from stars near the sun. He also developed the theory, to a certain extent on the philosophical side, but considerably on the analytical side, especially with regard to the electromagnetic and gravitational fields.

A ROYAL MEDAL, AWARDED TO DR. ROBERT BROOM.

During the course of thirty-three years' search in Australia and South Africa, Dr. Broom has made a very large number of important discoveries in vertebrate palæontology, embryology, and morphology that shed new light upon the problems of the origin of mammals, lizards, crocodiles, and birds. His researches represent the most significant contribution made by any one investigator to the determination of the relationships of the main groups of vertebrate animals and to the definition and solution of the problems involved in the evolution of the higher groups.

THE DAVY MEDAL, AWARDED TO PROF. FREDERICK GEORGE DONNAN.

Prof. Donnan is, like his master van 't Hoff, a man of ideas. Early in his scientific career he wrote on

the nature of soap emulsions and on the theory of capillarity and colloidal solutions. His theory of membrane equilibrium and membrane potential is an achievement of the first rank, and has been the starting-point of numerous studies not only in the domain of pure chemistry, but more especially in biochemistry, where the conditions for displaying the phenomena he predicted are often encountered. His researches on surface tension and absorption at liquid-liquid interfaces have led to results of the greatest interest, and his verification by means of nonylic acid of the Gibbs' absorption formula is a most brilliant experimental conception. A by-product of his activities during the War is a theory of the action of gas-scrubbers, based on the velocity of absorption of gases by liquids.

THE DARWIN MEDAL, AWARDED TO DR. LEONARD COCKAYNE.

A true naturalist, Dr. Cockayne has waited patiently upon facts before drawing conclusions. For more than thirty years he has made it his task to deepen and widen our knowledge of New Zealand botany in the broadest sense. He is one of the foremost living students of plant-association; the taxonomic studies rendered necessary by his ecological results have led to those remarkable discoveries of natural hybrids in New Zealand that have won for him a world-wide reputation and have made on modern thought an impression akin to that produced by the results of Darwin's studies of plants under domestication. Dr. Cockayne's researches have had, on sylvicultural and agricultural procedure, a practical bearing which has been appreciated by, and has influenced the policy of, New Zealand statesmen.

THE SYLVESTER MEDAL, AWARDED TO PROF. WILLIAM HENRY YOUNG.

Dr. W. H. Young has taken a very prominent part in the development of the modern theory of functions of real variables, and in its application to the theory of Fourier's and other series. His earlier work dealt chiefly with the theory of sets of points, and contains important developments on the lines laid down by G. Cantor and Harnack. He soon preceeded to apply this theory in the integral calculus, and he obtained a general definition of the integral which is essentially equivalent to, although somewhat less simple in form, that given about the same time by H. Lebesgue, which latter has become a corner stone of modern analysis. Much of Dr. Young's work has proved to be a starting point for further investigations by other mathematicians. By means of his conception of restricted Fourier's series he was enabled to devise a method by which conditions of convergence, summability, etc., known to hold good for Fourier's series, could be carried over to series of Legendre's and Bessel's functions.

THE HUGHES MEDAL, AWARDED TO M. LE DUC DE BROGLIE.

Maurice François César, Duc de Broglie, is distinguished especially for his pioneer researches on X-ray spectra and secondary β-rays. He was one of the first to obtain the complete emission spectrum of X-rays and to study X-ray absorption spectra, while his work on the magnetic spectrum of the β-rays, arising from the passage of X-rays through matter, has proved of great importance. He founded in Paris a private laboratory directed by himself, which is devoted to researches on X-rays and allied subjects.

Applied Chemistry.

PHYSICAL CHEMISTRY AND BIOLOGY.

THE first Liversidge lecture was delivered before the Chemical Society on Nov. 29 by Prof. F. G. Donnan, who discussed the applications of physical chemistry in the service of biology. In connexion with similar lectures to be provided by the University of Sydney, the Royal Society of New South Wales, and the Australasian Association for the Advancement of Science, this series of annual lectures has been established by the Chemical Society in accordance with the terms of a bequest by the late Prof. Liversidge, of the University of Sydney, a bequest which was made with the object of stimulating thought and encouraging the acquisition of new knowledge. Liversidge lectures delivered before the Chemical Society will be concerned with physical and inorganic chemistry, whilst another series of lectures, perpetuating the memory of the late Sir Alexander Pedler, will deal similarly with organic chemistry.

Prof. Donnan first referred briefly to the part played by organic and inorganic chemistry in the advancement of biology. Physical chemistry, as created by Raoult, van 't Hoff, Ostwald, Arrhenius, and Nernst, first began to exert a powerful influence on biology, although no period in the development of physical chemistry clearly marked the beginning of the application of that science to biological problems. The osmotic theory of semi-permeable membranes, based on the work of Pfeffer and van 't Hoff, was of exceptional importance in its explanation of the then mysterious vital action of the living cell. The triumph and development of the ionic theory has revolutionised a large part of the theory of solutions, and has been of correspondingly fundamental importance in the study of essential constituents of the living organism; the hydrogen ion activity determines the molecular state and colloidal condition of the amphoteric proteins in aqueous solution, and the optimum activity of enzymes. It is not surprising, therefore, that the delicate dynamic equilibrium of living protoplasm requires a close regulation of the hydrogen ion concentration. determinable by known or theoretically calculable ionic equilibria.

Prof. Donnan also referred during his discourse to the great biological importance of the thermodynamical studies of Willard Gibbs, to whom we owe very important considerations relating to surfaces of separation between different media. There exist at such surfaces powerful uncompensated fields of atomic and molecular forces, as a result of which molecules and ions are held or adsorbed in spite of general thermal agitation tending to disperse them. Some of the forces may be of considerable extent, and perhaps considerable symmetry, whilst others are highly localised; the latter are of great importance since they cause the orientation and regular arraying of molecules and ions at surfaces and surface films. "A living cell," said Prof. Donnan, "is not merely a little bag containing salts, proteins, sugars, fats, and enzymes in which chemical reactions occur as in a beaker or flask. There is organisation, and organisation in space means arrangement. In this orientation and arraying of molecules and ions at surfaces we may perceive, perhaps, the first faint glimmering of the organised arrangement of life's mechanism."

Finally, Prof. Donnan referred to three considerations of major significance which must be taken into account. First, that the laws of thermodynamics, being statistical in their nature, do not necessarily

apply universally in very small systems. Further, that modern quantum mechanics appears to provide for the recently postulated inexpressibility of the whole in terms of its parts. Again, that the determinism which is associated with Newtonian philosophy is now being rejected in favour of a less materialistic science. In a recent book, Prof. Eddington has shown that a particle may have position or velocity, but not both; it follows, therefore, that prediction of the future is a statistical problem. Modern science tends to acknowledge the element of volition.

CHEMICAL ENGINEERING.

Chemical engineering education and research in Great Britain, a matter which is of exceptional importance in the post-War development of British industry, formed the subject of the inaugural lecture delivered by Prof. W. E. Gibbs at University College, London, on Dec. 3. The age has passed when coal, for example, was regarded simply as a convenient combustible or as a raw material from which gas, coke, tar, and smoke can be obtained; the chemist to-day is altering the whole basis of coal valuation. Likewise, as Prof. Gibbs pointed out, the atmosphere has become a source of ammonia and nitric acid, as well as of oxygen; wood is being transformed into a variety of products in which we can no longer recognise the original material—paper, artificial silk, plastics, lacquers, sugar, and alcohol; waste products such as casein have provided the foundation of new industries.

Whereas the pioneering work connected with the establishment of new chemical industries—new reservoirs of national power and prosperity—and the better equipment of existing industries in the face of world-competition has its origin in the laboratory, it must be realised that the problems and difficulties that arise in a works, and may threaten not only economic success, but also the very practicability of a manufacturing process, are entirely different from those encountered in a laboratory. The successful transformation from the experimental to the commercial scale requires not only a sound understanding of the scientific principles which are being employed in a chemical reaction, but also it demands more than casual acquaintance with the theory and practice of civil, mechanical, and electrical engineering, with the control of labour, with the financial returns, and with market conditions and requirements. Such matters properly belong to the newly developing science of chemical engineering—a distinct and separate branch of science with its own problems, its own methods, and its own opportunities.

Prof. Gibbs stated the case for the specialised training of chemical engineers very simply as follows: "An industrial chemical process is at heart a chemical reaction, but the reaction is hidden away in an elaborate arrangement of plant and machinery. The engineer can generally fathom the meaning of the machinery, but the reaction baffles him. The chemist can understand the reaction if only he can find out where it is going on. Neither understands the complete process, nor can they together grasp it completely. For there is much in an industrial chemical process which only occurs when the work of the chemist and the work of the engineer are brought together. It has become necessary, therefore, to train men who shall be able to see the process as a whole. . . . This is the function of the chemical engineer."

Prof. Gibbs did not, however, disparage the work of those who, because of unusual opportunities, or as the result of long apprenticeship, have developed without specialised instruction into exceedingly able engineers; but he declared that the supply of able men from this source is, from the point of view of present needs, too slow and uncertain. He described in some detail the type of work which, in modern chemical industry, requires the co-ordinated knowledge and experience which is being made available, for example, at University College and the Imperial College of Science and Technology. The product which they aim at producing is (quoting from his predecessor, Dr. E. C. Williams) "a scientific man whose duty it is to plan the large-scale commercial operation of chemical processes, and to design and operate the plant required for the carrying out of the chemical reactions and physical changes involved."

The chemical engineer is not concerned with the original research, which is in the domain of the laboratory chemist, or with the construction of the plant, which is the business of the engineer. The chemical engineer should know when to sacrifice chemical efficiency to economic efficiency. He would of course have opportunities of original investigation in studying the peculiar problems that arise during the operation of a process.

Moreover, there are many problems concerning the physical and chemical behaviour of new structural materials, and of old materials under new conditions, that await solution. We require much more information concerning, for example, heat transfer through dividing walls, the power absorbed in transporting powders through pipe lines, the production of crystals from gases and liquids, the flocculation of fogs and smokes, the adsorption of vapours, and the behaviour of colloidal substances in large quantities. It is clearly desirable that chemical employers and chemical plant manufacturers should either undertake or endow research with the view of the acquisition of fundamental data, as well as the elucidation of specific problems.

University and Educational Intelligence.

CAMBRIDGE.—Mr. A. F. R. Wollaston has been re-elected fellow and tutor of King's College. Prof. S. Chapman has been appointed Rouse Ball lecturer in mathematics for the present year. Mr. A. S. Besicovitch has been appointed Cayley lecturer in mathematics. The Arnold Gerstenberg Studentship has been awarded to C. H. Waddington, Sidney Sussex College. The Raymond Horton-Smith Prize has been awarded to H. Gainsborough, Downing College, for his work on "So-called Lipoid Nephrosis"; *proxime accessit*, E. G. Holmes, Christ's College, whose subject was "Metabolism of Nervous Tissue."

The Court of the Goldsmiths' Company has resolved that "in view of the close association between the company and the metallurgical department at Cambridge, and in view of the distinguished work carried out by Mr. C. T. Heycock, F.R.S., during his tenure of the readership (from which he has just retired)," it will transfer ultimately a capital sum of £10,000 to increase the endowment of the Goldsmiths' readership in metallurgy.

A SCIENTIFIC research fellowship is being offered by Girton College, Cambridge, for research in mathematical, physical, and natural sciences, including engineering, medicine, and agriculture. The fellowship will be of the annual value of £300 and tenable for three years. Particulars are obtainable from the Secretary of the College, to whom applications should be sent on or before Feb. 1 next.

Calendar of Customs and Festivals.

ADDENDA.

Two feasts observed in Macedonia during the month of November may be noted for their bearing on the ecclesiastical calendar and popular belief.

November 18.

The feast of St. Plato the Martyr, which has been translated in popular speech into St. Plane Tree (Πλάτωνος—ἅι Πλάτανος). This is an important date in weather lore, especially on the coast, for not only is this holy day said to witness all kinds of weather, but also the weather at sundown will last through all the forty days of Advent.

November 21.

THE FEAST OF THE VIRGIN.—The month of November is known as the "Sower" (Σποριᾶς) and the Virgin is known as the "Patroness of the Seed-Time" (Ξεσποριτισσα), a very interesting attribution which directly identifies the Madonna as a fertility goddess.

December 12.

ST. FINNAN.—Confessor and Bishop of Clonard in Ireland in the sixth century. The day on which he is venerated, now fixed as Dec. 12, was in the Highlands of Scotland formerly celebrated on the shortest day of the year. The eve, being the longest night, was spent in festivities. It was a favourite occasion for playing tricks on children. They were told that on this night the rain is wine and the stones are cheese. They were sent out to watch for the transformation or to sip water from a tub until it is turned to wine—a trick which preserved vaguely a belief in magical forces operative on one of the most critical occasions of the year.

ST. CORENTIN, Bishop of Quimper, probably in the fifth century. The son of a British nobleman, he is said to have retired to a forest in the parish of Ploumadiern, where he passed several years in solitude. The association of his cult with Quimper brings it into relation with earlier belief, for not only was it the religious centre of that part of Brittany which maintained its independence of Clovis and his successors, but also as "the place of the meeting of the rivers," it was an important centre of Breton cult, while the Counts of Cornouailles, one of whom is said to have given his palace at Quimper to the Bishop, were themselves in legend connected with the cult of a sea and river goddess. The cult of a Corentin or Cury also appears in Devon and Cornwall as a hermit at the foot of a hill Menehent.

December 14.

ST. TIBBA'S DAY.—A day which was at one time devoted by the fowlers and falconers of Rutlandshire to the veneration of this saint, whom they regarded as their patroness. St. Tibba and her cousin St. Eabba were in early life passionately devoted to the pursuit of hunting, but afterwards became saints. Ryhill in Rutlandshire was the centre of the cult, and Camden says that this superstition prevailed among the people to such an extent as to make them forgetful of the true god in their devotion to this pagan goddess, a kind of Diana.

The remains of St. Tibba were translated to Peterborough Cathedral, and the true character of her shrine and sacred well were forgotten, the latter in local legend becoming associated with a queen who used to climb the hill and bathe in the spring daily. Its name, from St. Tibba's Well, was corrupted into Stibba's Hill Well. Anniversary meetings were once held on the brow of the hill at Halegreen, a name said to be derived from the solemnities once enacted there, and evidently therefore a traditional place of some early religious ceremonial. The memory of St. Eabba is preserved in the corrupted form of Staplesford (St. Eabba's Ford) Bridge above Ryhill, where was situated a well once sacred to her but afterwards known to shepherds as St. Jacob's Well. The association of a goddess of the ford, *i.e.* of the river, with hunting, is worthy of note.

THE GROWTH OF RITUAL IN INDIA.—Beliefs and ritual practices connected with agriculture among the peasant population of India not only serve to throw light upon the development of a number of general religious ideas, but also illustrate or elucidate some of the more primitive survivals among the European peasantry.

In the Karnatak, the plough is worshipped before it is taken to the fields, and the drill is worshipped at the time of sowing. Not only is the corn itself worshipped at harvest time, and coconuts broken over the heap of the grain, but also the baskets in which the ears are gathered. The bullocks and drivers bringing in the harvest in the Deccan are worshipped by lighted lamps being waved before them. A further stage towards the development of the idea of a deity is seen in the worship of a consecrated stone besmeared with red powder, which may be taken to represent the blood of a victim, by the side of a field.

Similarly, in the Thana District (Bombay), in choosing the deities of a newly founded village, one of them, Cheda, is represented by a long piece of wood or stone besmeared with red powder. This deity may be established without the aid of a Brahman, and is, therefore, still at a very primitive stage of religious thought. In some parts the people believe that a deity resides in every farm or collection of fields, and that good or bad harvests result in his pleasure or displeasure. The genesis of the animal god can be seen in the figure of a tiger made of canes, which is posted in a conspicuous place in the fields of sugar cane. One of the party personates the tiger and is driven off with pieces of cane. At Malad (Thana District) the tiger god Waghoba is worshipped on the 'Tiger Twelfth'—the twelfth day of the month Ashvin (September–October) for the protection of cattle.

Out of these beliefs have grown the cults of the godlings (Bhuta-Devatas) who are the field guardians. In some cases the field guardians are also the Brahmanic godlings, Maruti and Shiva, to whom field-coconuts and flowers are offered. To the others the peasants offer coconuts and sometimes goats or sheep. The propitiation of these spirits tends to centre around certain critical points of the agricultural year, ploughing, sowing, transplanting in the case of the rice crop, and harvest, which fall in certain fixed months and on certain days, thus becoming calendrical. Thus in the Katnagiri district on the no-moon day of Jyeshth (May–June), the people assemble in the temple of the village deity and perform a rite in order that they shall have a good crop, that their village may be free from disease, and that their cattle may be protected ; and a similar rite is performed on the first day of the bright half of the month of Margashirsh (November–December), when a goat or sheep is sacrificed on the boundary of the village. The goddess Khema is worshipped to obtain good crops and for the protection of the cattle, but on the full-moon day of Margashirsh a special worship takes place and the sacred gondhal dance is performed, while in Kankaoli, also in the Bombay Presidency, the villagers worship the minor deities of the field with offerings on certain days of each month from Kartik (October–November) up to March.

Societies and Academies.

London.

Optical Society, Nov. 8.—**T. Smith**: (1) On systems of plane reflecting surfaces. An algebraic method is evolved of finding the co-ordinates of the image of any point and of the direction of the emergent portion of any given incident ray after reflection at any number of plane reflecting surfaces. Systems of reflectors are classified according to the nature of the self-conjugate region of the field. A method of designing a system having any assigned properties is described. Suitable criteria are given to determine whether with a prismatic system the whole is non-dispersive, and whether total internal reflection takes place at any given surface; also the boundary conditions at each surface are found. The calculations are simple and free from any ambiguity of sign.—(2) Reflecting systems for image inversion. The above method is applied to an inverting prism. Four surfaces involve oblique refraction into the prism whatever the number and order of the reflections. With five surfaces one form is possible with four reflections. All possible arrangements with six reflections at five surfaces are considered, and the application of the method to prisms with a greater number of reflections is illustrated.—**L. C. Martin** and **T. C. Richards**: The relations between field illumination and the optimum visual field for observational instruments. Experiments based on the application of the results of recent studies on *spatial induction* in vision to determine the conditions governing the optimum size of visual field under certain conditions are described. The results have a bearing on recent efforts to enlarge greatly the fields of view of binoculars, indicating that small fields are better under certain conditions.

Linnean Society, Nov. 15.—**H. Hamshaw Thomas**: Further observations on the cuticle structure of Mesozoic Cycadean fronds. The typical members of the genus *Pterophyllum* are widely different in their epidermal structure from the fronds which have often been placed with them as the section Anomozamites. The rare Yorkshire plant *Pterophyllum Nathorsti*, on its cuticle structure, should be regarded as the type of a new genus. There is no justification for the separation of the numerous forms of *Pterophyllum* from the Lunz Beds (Upper Trias) of Austria into a number of species distinguishable by their dimensions. Cuticle structure indicates that the Palæozoic fronds from the Coal Measures of Blanzy and Commentry in France are more closely allied to the Mesozoic genus *Nilssonia*, and cannot be classed as true Pterophyllums.—**A. H. Clark**: On some recent crinoids in the collection of the British Museum.—**C. A. Nilsson-Cantell**: New and interesting species of *Scalpellum* from a telegraph cable near the coast of North Chile. Four species (two of them new) of barnacles of the genus *Scalpellum* obtained at a depth of 343-400 fathoms are described.—**W. M. Tattersall**: *Asellus cavaticus* Schiodte, a blind isopod new to the British fauna, from a well in Hampshire. Though new to the British fauna, it is rather widely distributed in subterranean waters in France, Germany, and possibly Switzerland. It is a typical cavernicolous species without eyes and without any trace of pigment. It must have been isolated in England at least since early Tertiary times, yet has apparently remained unchanged during that long period of isolation, probably as the result of the very uniform conditions obtaining in underground waters.

Royal Meteorological Society, Nov. 21.—**F. J. W. Whipple**: On the association of the diurnal variation of electric potential gradient in fine weather and the distribution of thunderstorms over the globe. It has been suggested by C. T. R. Wilson that the connexion between the upward currents produced by thunderstorms and the downward currents elsewhere is via the Heaviside layer. Storms are least frequent from 2h. to 4h. G.M.T. (when it is afternoon over the Pacific) and most frequent between 14h. and 20h. G.M.T. (afternoon hours for Africa and S. America). Observations of potential gradient in polar regions and at sea, *i.e.* in parts of the world where there is likely to be little systematic variation in the conductivity of the air, indicate that the gradient has its minimum and maximum values within these same hours. The results are consistent with the Wilson hypothesis.—**N. K. Johnson**: Atmospheric oscillations shown by the microbarograph. The microbarograph invented by Sir Napier Shaw and the late Mr. W. H. Dines frequently gives a regular wave-like record representing oscillations of atmospheric pressure with periods ranging from about 6 minutes to an hour, with a marked maximum for a period of about ten minutes. These oscillations originate at the interface of two air currents possessing different densities and motions. The natural period of vertical oscillation of the atmosphere is connected with the lapse rate of temperature, and the most frequent period of oscillation recorded corresponds with the most frequent lapse rate.

Edinburgh.

Royal Society, Nov. 5.—**J. R. Thompson**: The general expression for boundary conditions and the limits of correlation. The study of correlated variables suggests a complex array of factors, among which it is required to state the highest degree of generality we are compelled to assume and yet retain the possibility of producing a given set of correlations. This purpose is served by the boundary conditions, which can be expressed in general by a determinant of the correlation coefficients and one parameter k, the latter taking the value -1, -2, -3, etc., respectively according as the 1st, 2nd, 3rd, etc., boundary condition is required. When $k = +1$ the determinant gives a condition stated by J. C. Maxwell Garnett (*Proc. Roy. Soc.*, 1919) as indicating the presence of two general factors in three variables and three general factors in four variables. Agreement between these results and the boundary conditions is established by a definition of Maxwell Garnett's general factor in terms of ultimate elements.—**John Mackie**: Mathematical consequences of certain theories of mental ability. On the supposition that four mental abilities are due to N variable factors, and that the proportions in which they act are determined by chance, the probable value of the tetrad-difference F is calculated. Following the geometrical treatment employed by Maxwell Garnett, we find that if N is large, σ_F is approximately inversely proportional to $\sqrt{N}$, so that by supposing N to be large we get σ_F to be small. The various abilities are represented by directed lines in N-dimensional space, and by considering all possible lines and taking any four at random, we obtain as a probable result $F = O \pm$ a small quantity.—**T. P. Black**: Mental measurement: The probable error of some boundary conditions in diagnosing the presence of group and general factors. J. Ridley Thompson, by examining correlation coefficients, has developed criteria for testing whether in mental activities 'general' or 'group' factors are necessarily present. In the case of three variables and $K = -1$ the probable error of his function reduces to

$$\frac{2 \cdot 698}{\sqrt{N}}\sqrt{(1-P_{12}{}^2)(1-P_{23}{}^2)(1-P_{31}{}^2)}.$$

In the development of the mean squared deviation,

terms of order $1/N^2$ have been neglected and normal distribution of the variables has been assumed throughout. —**W. F. P. M'Lintock and J. Phemister**: A gravitational survey over the buried Kelvin Valley at Drumry, near Glasgow. This survey, with the Eötvös torsion balance, was undertaken by H.M. Geological Survey to amplify what was previously known from a series of isolated borings. The average specific gravity of the sands and clays filling the valley is 1·72, and that of the underlying rocks (Carboniferous Limestone Series), 2·3. The pre-glacial valley of the Kelvin, filled in places to a depth of 300 feet with sand and clay, can be traced from Kirkintilloch to Drumry, where it was supposed to fork against a rock-mass which there rises to 74 feet from the surface, one branch continuing westwards to the north of that mass as a deep channel. The gradients have been determined at 68 stations and an isogam map has been constructed from these gradients.—**L. N. G. Filon**: On a quadrature formula for trigonometrical integrals. Formulæ of numerical integration such as Simpson's Rule are not applicable as they stand to cases where the integrand is a function which has rapid oscillations, like $f(x) \sin kx$. A formula is derived appropriate for this contingency; it is a generalisation of Simpson's Rule, and reduces to it when k is zero.

PARIS.

Academy of Sciences, Oct. 15.—**H. Andoyer**: The analytical theory of perturbations and the theorem of Poisson.—**Maurice Hamy**: A property of diffraction by a circular opening.—**Ch. Fabry**: The rôle of the atmospheres in the occultations of the stars by the planets. A discussion of the probable effects of atmospheres on the planets on the phenomena observed during the occultation of a star.—**Ch. Nicolle, C. Mathis, and Ch. Anderson**: The unicity of the recurrent spirochætes of the Dutton group.—**Georges Giraud**: Non-linear partial differential equations of the second order of the elliptic type.—**Florin Vasilesco**: The surfaces of level of the potential of an aggregate of points.—**N. Cetajev**: The Poisson stability.—**F. Rochefort**: A new method of feeding explosion motors. A special form of pulveriser is described capable of utilising gas oil as fuel, for which the flexibility of the petrol carburettor is claimed.—**J. Peltier**: The equations of motion of a motor-car.—**R. Mazet**: Flow through a long, narrow rectangular orifice.—**D. Eginitis**: The problem of the tide of Euripus.—**R. Jarry-Desloges**: Researches on the position of the axis of rotation of the planet Venus.—**Paul Lévy**: The vibrating spaces of M. Winter.—**W. Broniewski and B. Hackiewicz**: The structure of the copper-tin alloys. In this work an attempt to reach true equilibria in the alloys was made by means of prolonged annealing, in one case for 7000 hours at 299° C. The slowness with which equilibrium is established, as established by this work, proves the preponderating importance of annealing in the study of the structure of alloys by indirect methods.—**Jean Cabannes**: The depolarisation of the secondary radiations in the complex light which results from the molecular diffusion of a monochromatic radiation.—**J. Harroy and A. Brichant**: The discovery of a coal basin in eastern Morocco.—**Marcel E. Denaeyer**: Geological sketch of French equatorial Africa, of the Cameroons, and neighbouring regions.—**L. W. Collet, R. Perret, M. Billings, and Mlle. R. A. Doggett**: The presence of the crystalline of the Aiguilles Rouges massif in the Cirque du Fer à Cheval (Hautes Alpes limestones of Sixt, Haute Savoie).—**Ch. Courtot**: The condensation of chloroindane with phenols.—**Bourguel and Rambaud**: The catalytic influence of the hydrogen ions in the internal dehydration of a cis-ethylenic γ-glycol in the presence of water.—**R. Combes**: Critical study of the method of Sachs applied to the measurement of migrations of substances. The author considers that the errors inherent in Sachs's method render it useless for the study of the migration of substances in leaves.—**L. Maume and J. Dulac**: The positive, zero, and negative antagonism of binary mixtures of electrolytes with regard to plants.—**André Piédallu and A. Balachowsky**: The utilisation of chloropicrin against cochineal insects harmful to orange trees or date palms. Chloropicrin is effective for this purpose if used in doses of 15-20 gm. per cubic metre.—**R. Guillin**: The integral dissociation of silicates by carbonic acid, by humic acids, and connected reactions. Whatever may be the nature of the humus-bearing soils, and whether containing lime or not, carbonic acid and the humic acids can cause the disintegration of silicate rocks, sodium and potassium being first eliminated, then lime and magnesia, and finally the aluminium, the latter alone remaining fixed to the humic acids.—**Philippe Fabre**: The inefficacity of prolonged continuous currents in neuro-muscular stimulation.—**René Hazard and Mlle. Jeanne Lévy**: The cardiovascular action of the semicarbazone of tropinone and of the oximes of tropinone and pseudo-pelletierine.—**A. Paillot**: Experimental amicrobial silk-worm disease (*gattine*) and the rôle of intestinal cytotoxic substances in the epidemiology of silk-worm diseases.—**Moycho**: The action of bacterial proteolytic enzymes: the influence of pH on proteolysis. In acid media, pH 4, the proteolytic enzyme of *B. pyocyaneus* does not act on gelatine, whilst the enzyme of *B. prodigiosus* acts with difficulty. As the acidity is reduced the proteolytic action increases, reaching a maximum at about pH 8, after which it diminishes.—**R. Douris and J. Beck**: A simple reaction for differentiating normal and syphilitic sera with the aid of organic colloids. The proposed reagent is a solution of sodium oleate acidified in the presence of the serum with dilute phosphoric acid. Advantages are claimed for this sero-diagnostic method over those in ordinary use for the detection of syphilis.—**Y. Manouélian and J. Viala**: The nerve cells and the virulence of pneumogastric in canine hydrophobia.—**Bordier**: A new application of high frequency currents: medicinal d'Arsonvalisation.

Oct. 22.—**G. Bigourdan**: Description of a new form of comet finder.—**Ch. Fabry**: The rôle of the atmospheres in occultations of stars by the planets. Assuming the existence of atmospheres on the planets, details are given of the effects on the occultation of stars which might be expected. The cases of Mars, Mercury, Venus, Jupiter, Saturn, and the moon are considered.—**Maurice de Broglie**: Remark on the fine structure of the Compton effect. —**Jean Perrin and Mlle. Choucroun**: The velocity of photochemical reactions. A photochemical study of two chemical reactions where the reagents were practically non-fluorescent. The law of mass action was found to apply to each of these.—**J. Auclair and J. Villey**: The thermodynamic diagram of the Rochefort system.—**Delloue**: Lines of curvature passing through an umbilicus.—**Laurence Chisholm Young**: The change of variable in simple absolutely convergent integrals.—**Fr. Wolf**: Theorems of unicity of trigonometrical series representing pseudo-periodic functions.—**Grialou**: Rotational movement of non-perfect liquids with permanent regime.—**Mokrzycki**: The determination of the characteristics of an aeroplane based on the petrol consumption.—**N. Stoyko**: The influence of the personal equations on the determination of the time by the meridian telescope, with an impersonal micro-

meter.—L. Goldstein : The [illegible] caused in wave mech[illegible].—Néda Marinesco : [illegible]ielectric properties and [illegible] structure of absorbent colloids. From measurements of the dielectric constants of solutions of varying concentrations of methæmoglobine, soluble starch, and gum arabic, a figure is calculated giving the number of cubic centimetres of water dielectrically saturated and fixed per gram of solid colloid.—R. de Mallemann : The internal field of polarisation. A new theoretical expression for the refractive power is calculated. The Lorentz factor $(K+2)/3$, or Gladstone factor $(\sqrt{K}+1)/2$ is replaced by $3K/(2K+1)$.—Paul Soleillet : The polarisation of the resonance radiations of zinc. From the experimental results given, the approximate value of the mean life of the atom in the excited state is calculated on the basis of Elridge's theory ; it is $T=10^{-5}$.—A. Nodon and G. Cuvier : Researches on the radioactivity of wines. The radioactivity found in the specimens examined varied between 0·1 and 0·01 that of uranium.—J. Errera : Molecular associations. Relations between the vapour pressure of binary liquid mixtures and the polarity of the molecules of the constituents.—R. Levaillant : The preparation of neutral sulphuric esters. Details of the method of preparation of *n*-propyl chlorsulphonate and *n*-propyl sulphate and of the corresponding β-chlorethyl compounds.—N. Menchikoff : The age of the Ougarta grits (Western Sahara).—A. Rivière : The prolongation into Italy of the Pyrenees-Provençal irregularities of the east of the Maritime Alps.—Auguste Lumière and Mme. Malespine : Protection against anaphylactoid shock by means of magnesium hyposulphite. The shock produced by the injection of barium sulphate suspensions can be minimised by the simultaneous injection of a solution of magnesium hyposulphite.—A. Policard : The variations of thermal retraction shown by various regions of the ossification cartilage.

GENEVA.

Society of Physics and Natural History, Oct. 25.—Tiercy : The method of indicating gaining or losing of chronometers. A recent discussion compares the method used by seamen, in which the *correction* is given with its algebraic sign, with that of the clock-makers, who give the *rate*, that is to say, the quantity by which the chronometer gains or loses : these two magnitudes are connected by the relation : Correction = −(rate). He decides in favour of the clock-makers' view, which he considers more in accordance with the interpretation of the plain meaning of the words gain or loss.—R. Matthey : The chromosomes of the viper (*Vipera aspis*). The diploid number $2N$ is 41. There are 21 macrochromosomes and 20 microchromosomes. The haploid plates of the first kinesis amount to 11 large elements and 10 small ; those of the second kinesis have sometimes 11, sometimes 10 macrochromosomes, hence there is male digamety and heterochromosomy of the type X0.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 9, Sept. 15).—D. L. Webster, H. Clark, R. M. Yeatman, and W. W. Hansen : Intensities of *K*-series X-rays from thin targets. The targets consisted of films of silver deposited by evaporation of molten silver on to a beryllium block ; their thickness ranged from about 30 A. to about 280 A. Such films allow almost all the cathode rays to pass without appreciable loss of energy, and give a measure of the relative intensities of *K*-series X-rays. Present theories of the effect are only qualitatively in accord with the results.—C. J. Brasefield : The spectrum of the hydrogen molecular ion. A canal ray beam was photographed 0·5 mm. behind the cathode and perpendicularly to the beam, with varying pressures. Photometric records of the plates showed that the lines could be divided into three groups : (1) a large number increased rapidly in intensity with increasing pressure ; they are due to excitation of the resting gas by moving hydrogen molecular ions ; (2) a group of lines of almost constant intensity ; and (3) a third group, which increased in intensity to a maximum at pressures of 0·005-0·008 mm. of mercury, and then decreased ; these are due to hydrogen molecular ions (H_2^+). These last have been arranged in branches.—Louis Harris : The absorption spectrum of nitrogen dioxide. Pure nitrogen dioxide was examined in quartz cells. Keeping one set of cells at 125°-140° C. gave the spectra of the single molecules, NO_2 ; reducing the temperature gave spectra of mixtures of single, NO_2, and double molecules, $(NO_2)_2$. At −42° to 28° C., spectra were obtained of the double molecules $(NO_2)_2$ in the gaseous phase alone. The single molecules give many bands, several with fine structure, between 6000 A. and 2250 A. ; distinct bands appear in the region 2600-2250 A. Absorption due to double molecules is continuous ; two bands with maxima at 3500 A. and farther in the ultra-violet merge into a continuous band extending from 4000 A. into the far ultra-violet at high pressures.—R. C. Gibbs and C. V. Shapiro : The relation of hydrolysis to the validity of Beer's law. This law, that extinction, for a given thickness, is proportional to the concentration, is based on the assumption that no changes occur in the character of the absorbing centres with varying concentration. Data obtained with phenol phthalein and its derivatives and other indicators in alcoholic solution show that this assumption is not justified owing to the occurrence of hydrolysis, which produces new types of absorption centres. Hence solutions of 'neutral' salts of the phthalein series do not give the true absorption of the ion of the alkali salt.—Richard C. Tolman : Further remarks on the second law of thermodynamics in general relativity. An expression for the second law applied to an infinitesimal four-dimensional region in flat space-time is obtained from the older thermodynamics, and, on the basis of the equivalence hypothesis, this is regarded as true in curved space-time. The expression is generalised in co-variant form.—J. R. Green and R. J. Lang : Series spectra of cadmium-like atoms. The results for Sb IV have been classified.—Donald A. Johansen : The hypostase : its presence and function in the ovule of the Onagraceæ. The hypostase is a group of thick-walled cells between the bases of the two integuments of the ovule and directly on top of the end of the vascular bundle entering the latter. From an examination of many species of Onagraceæ from different habitats, it appears that it is an acquired characteristic arising as required to stabilise the water balance of a resting seed which will be dormant during a hot, dry season.—G. H. Parker : Glycogen as a means of ciliary reversal. Filter paper, which was rejected by the sea-anemone, *Metridium marginatum*, was carried in towards the mouth when impregnated with glycogen, due apparently to a reversal of the ciliary current.—H. J. Muller : The production of mutations by X-rays. An account of the work on the fly *Drosophila* and other organisms, with a bibliography. β-radiation appears to be most effective ; the number of mutations varies with the dosage, but the 'degree' or character of the individual mutations does not. Changes other than losses in the chromosomes have been found.—Morris Marden : On the roots of a derivative of a polynomial.—Tracy Yerkes

...: Concerning the *G group of transforma-s.—Oswald Veblen: Conformal tensors and connections. The system of invariants appropriate to the conformal geometry of Riemannian spaces.—Aristotle D. Michal: The group manifold of finite continuous point and functional transformation groups.

Official Publications Received.

BRITISH.

Development Commission. Eighteenth Report of the Development Commissioners for the Year ended the 31st March 1928. Pp. 200. (London: H.M. Stationery Office.) 3s. 6d. net.

Proceedings of the Royal Society. Series A, Vol. 121, No. A787. Pp. 477. (London: Harrison and Sons, Ltd.) 16s.

The Journal of the National Institute of Agricultural Botany. Vol. 2, No. 1. Pp. 84. (Cambridge: W. Heffer and Sons, Ltd.) 2s. 6d. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 383, November. Pp. 1101-1244+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Transactions of the Royal Geological Society of Cornwall. Vol. 16, Part 1: The One Hundred and Fourteenth Annual Report of the Council, with the Reports of the Treasurer and Curator and Papers read to the Society. Pp. 81. (Penzance.) 4s.

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1927-28. Pp. 26. (Aberdeen.)

Government of Madras. Administration Report of the Government Museum and the Connemara Public Library for the Year 1927–28. Pp. 16. (Madras: Government Museum.)

Latex. By Dr. Henry P. Stevens. Pp. 68. (London: The Rubber Growers' Association, Inc.)

Report of the International Conference on Cancer, London, 17th-20th July 1928, held under the Auspices of the British Empire Cancer Campaign. Pp. xxi+688. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd.)

FOREIGN.

United States Department of Agriculture. Technical Bulletin No. 80: Tests of Blowfly Baits and Repellents during 1926. By D. C. Parman, E. W. Laake and F. C. Bishopp, and R. C. Roark. Pp. 15. (Washington, D.C.: Government Printing Office.) 5 cents.

Department of Commerce: Bureau of Standards. Research Paper 29: Thermal Expansion of Magnesium and some of its Alloys. By Peter Hidnert and W. T. Sweeney. Pp. 771-792+2 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 8: Schools for the Deaf, 1926–27. Pp. 17. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 73, Art. 22: Tertiary Fossil Plants from the Argentine Republic. By Edward W. Berry. (No. 2743.) Pp. 27+5 plates. (Washington, D.C.: Government Printing Office.)

Bergens Jæger- og Fiskerforening. Rypeundersøkelsen 1921–1927. Pp. 18+18+21+9+4+20+41+8+8+54+18+84+8+5+8+9+71+5+8+67+16+52+88+49+85+84+118. (Bergen: A/S John Greigs Boktrykkeri.)

The Museum of the Brooklyn Institute of Arts and Sciences. Science Bulletin, Vol. 3, No. 5: Heterocephalus, the remarkable African Burrowing Rodent. By W. J. Hamilton, Jr. Pp. 173-184+3 plates. (Brooklyn, N.Y.)

Department of the Interior: U.S. Geological Survey. Bulletin 775: Geology and Lignite Resources of the Marmarth Field, Southwestern North Dakota. By C. J. Hares. Pp. vi+110+14 plates. 35 cents. Bulletin 798: Geology of the Muddy Mountains, Nevada; with a Section through the Virgin Range to the Grand Wash Cliffs, Arizona. By Chester R. Longwell. Pp. vi+152+17 plates. 50 cents. Bulletin 802: Bibliography of North American Geology for 1925 and 1926. By John M. Nickles. Pp. iii+286. 40 cents. Professional Paper 153: Studies of Basin-Range Structure. By Grove Karl Gilbert. Pp. vii+92+40 plates. 60 cents. Water-Supply Paper 540: Ground Water in the New Haven Area, Connecticut. By John S. Brown. Pp. vi+206+15 plates. 60 cents. Water-Supply Paper 581: Surface Water Supply of the United States, 1924. Part 1: North Atlantic Slope Drainage Basins. Pp. vi+246. 25 cents. Water-Supply Paper 590: Surface Water Supply of the United States, 1924. Part 10: The Great Basin. Pp. v+181. 20 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

FRIDAY, DECEMBER 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—G. F. Jenkins, T. B. Layton, E. D. Davis, and others: Discussion on Meningitis.

INSTITUTION OF WATER ENGINEERS (at Geological Society), at 10.30 A.M.—J. Bowman: The Consumption and Waste of Water.—E. J. Rimmer: Legal Considerations relating to the Administration of Engineering Contracts.—A. W. Burtt: The Sandfields.—W. T. Halcrow, G. B. Brook, and R. Preston: The Corrosive Attack of Moorland Water on Concrete.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion on Atmospheric Ionisation. Chairman, Dr. G. C. Simpson. Discussion to be opened by Prof. J. Nolan, and continued by Dr. J. S. Owens, Prof. A. M. Tyndall, and R. S. Watson.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—C. H. Faris: The Application of Electro-deposited Metals to Engineering.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—F. W. Thomas: Weak R in Central Asia.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College for Women), at 5.30.—J. Littlejohns: The Appreciation of Pictures.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Prof. H. E. Armstrong: Hurter Memorial Lecture.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.30.—K. O. Keller: Combustion and its Difficulties in Marine Oil Engines.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institution of the Rubber Industry—Manchester Section) (at Geographical Hall, Manchester), at 7.—Dr. L. Auer: Colloid-Chemical Changes in Rubber and in Fatty Oils.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—W. Holmes: Load Levelling Relays and their Application in Connexion with Future Metering Problems.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—F. E. Robinson: Works Committees.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.—H. Bairstow: Bromoil Transfer.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Lt.-Col. J. T. C. Moore-Brabazon: The Future of Coal in relation to Industry (Presidential Address).

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—J. G. C. Leech: St. Austell Detritals.—H. G. Smith: Some Features of Cornish Lamprophyres.

TEXTILE INSTITUTE (Lancashire Section) (jointly with Bolton and District Managers', Carders', and Overlookers' Association) (at Saddle Hotel, Bradshawgate, Bolton), at 8.—A. Roe: Cleaning of Cotton in the Blowing Room.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—S. Rowbotham: Preliminary Medication in Anæsthetics.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea).—Prof. T. C. James: Pollution of Rivers.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Sir E. Farquhar Buzzard: The Harvey Tercentenary Film.

SATURDAY, DECEMBER 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Bayes: The Gulf between Painter and Public (I.).

MINING INSTITUTE OF SCOTLAND (at Royal Technical College, Glasgow), at 3.—J. S. Frame: Pavement Brushing versus Roof Brushing.—*Papers to be discussed*:—An Experience of Machine Mining in a Highly Inclined Seam, J. M. Williamson and J. Bilsland; Some Impressions of German Mining, D. C. Gemmell and J. Heron; Tru-lay Wire Ropes and Tru-lock Fittings, A. T. Adam.

MONDAY, DECEMBER 10.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Dr. H. Jeffreys: On the Transverse Circulation in Streams.—J. Hargreaves: The Dispersion Electrons of Lithium.—W. R. Harper: The Obliquity Function to be Used in the Approximate Theory of Diffraction.—C. E. Eddy: The Passage of β-rays through Matter.—*Papers to be communicated by title only*:—H. D. Ursell: (a) Cayley's Problem; Seven Lines on a Quartic Surface; (b) Coincidence Formulæ in Geometry.—J. A. Todd: On the Number of Planes in Hyperspace which Satisfy a Certain Set of Conditions.—W. N. Bailey: Note on Bateman's Expansion in Bessel Functions.—H. Pfeiffer: Der Isoelektrische Punkt von Zellen und Geweben.—P. Tate: The Dermatophytes, or Ringworm Fungi.—W. Seifriz: The Structure of Protoplasm.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—S. W. Boggs, A. R. Hinks, and others: New Map Projections.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.—Surg.-Comdr. P. M. Rivaz: Some Common Problems in Naval Hygiene.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—Major C. G. Nevatt: Experiments on Self-Energised Brakes.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—E. W. Dorey and others: Discussion on Power Factor Tariffs and Methods of Metering.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (in Laboratories of Applied Electricity, Liverpool University), at 7.—E. H. Shaughnessy: Transatlantic Radio Telephony.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—E. B. Wedmore, W. B. Whitney, and C. E. R. Bruce: An Introduction to Researches in Circuit Breaking.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institution of the Rubber Industry) (at Blackfriars Theatre, William Street, E.C.4), at 7.30.—W. H. Paull: The Tyre as an Article of Manufacture and Usage.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Branch) (at Borough Polytechnic), at 7.30.—E. T. Ollett: Air Filtration.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—F. Hudson: Scottish Moulding Sands and their Application to Non-Ferrous Casting.

SURVEYORS' INSTITUTION, at 8.—F. G. Fleury: The Recent Rating Acts in Operation.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College).—Miss M. B. Stott: An Experiment in Vocational Guidance.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at South Wales Institute of Engineers, Cardiff).—W. W. Woodhouse: Overhead Electric Lines.

TUESDAY, DECEMBER 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: Diamonds (IV.).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. A. Wade: Madagascar and its Oil Lands.

ILLUMINATING ENGINEERING SOCIETY (at 15 Savoy Street), at 6.30.—H. Lingard: The Use of Electric Lighting for Advertising Purposes.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—A. Greenfield: Practical Refrigeration for Ships.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—W. W. E. French: Short-Circuits in Large Power Systems.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—L. Romero and others: Discussion on Tariffs.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—F. Lydall: The Electrification of the Pietermaritzburg-Glencoe System of the South African Railways.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. Coleman: From Suez to the Himalaya.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—Major C. G. Nevatt: Experiments on Self-Energised Brakes.

PHARMACEUTICAL SOCIETY, at 8.—Dr. Katharine H. Coward: Recent Research on the Vitamins.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—S. K. Ratcliffe: The Impact of America on Western Civilisation (Lecture).

WEDNESDAY, DECEMBER 12.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Prof. Franchini: Malpighi.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—J. Whitehouse and others: Discussion on Methods of Reducing Temperature in Deep Mining Work.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Institution of the Rubber Industry) (at 36 York Place, Edinburgh), at 7.30.—R. Wheatley: Methods of Heating in the Rubber Industry.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—B. Thomas and F. J. Elliott: The Changes in Soil Reaction Effected by Long Continued Manuring.

ROYAL SOCIETY OF ARTS, at 8.—G. G. Blake: Applications of Electricity to Medical Practice.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—U. R. Evans: The Corrosion of Metals, with Special Reference to Protective Metallic Coverings.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Dr. M. Ginsberg: Interchange between Social Classes.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Royal Philosophical Society, Glasgow).—Dr. T. Gray: Low Temperature Carbonisation of Coal.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Engineers' Institute, Cardiff).—Dr. S. Wolff and others: Discussion on The Scope of a Chemical Engineer, with Special Reference to Boiler-house Practice.

THURSDAY, DECEMBER 13.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. A. W. Hill: A Botanist's Official Tour in Australia and New Zealand.—Dr. S. L. Hora: Evolution: Divergent and Convergent.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: Asymptotic Expansions of Products of Bessel Functions.—T. W. Chaundy: A Diophantine Trifle.—P. J. Daniell: Stieltjes Derivatives.—W. L. Ferrar: On Sequences of Analytic Functions.—Prof. L. J. Mordell: Poisson's Summation Formula and the Riemann Zeta Function.—E. G. Phillips: Note on Summation of Series.—E. G. C. Poole: Dirichlet's Principle for a Flat Ring (Second Paper).—Katherine I. Sayers: Cesàro Summation of Stieltjes-Fourier Series and their Conjugates.—W. M. Shepherd: Note on Generalised Plane Stress.—Mary Taylor: On the Existence and the Uniqueness of the Solution of Cauchy's Problem for a System of Two First Order Partial Differential Equations.—Prof. E. T. Whittaker: On the Recurrence Formula for the Mathieu Functions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir Richard Paget, Bart.: Human Speech: a Musical Phenomenon: Some Conclusions (II.).

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 7.—Dr. L. H. Lampitt: Developments of Dried Milk Industry, with Special Reference to Spray Drying.

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—E. Player: Magnesium Alloys for Engineering.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Informal Meeting), at 7.—F. J. Tritton and others: Discussion on The Three-Colour Carbro Process.

INSTITUTION OF CIVIL ENGINEERS (Yorkshire Association) (at Hotel Metropole, Leeds), at 7.30.—A. H. D. Markwick: Power Station Construction.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—H. K. Hunter: Radio Receivers: Design, Practice, and Tendencies in 1928–29.

INSTITUTE OF METALS (London Local Section) (jointly with Institute of British Foundrymen) (at 83 Pall Mall), at 7.30.—R. B. Deeley: Aluminium-Silicon Alloys; their Properties and some Applications.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—B. E. Mourashkinsky and Miss M. Savostianoff: The Measurement of Axial Aberrations of Telescopic Systems of Small Magnification.—T. Smith: Note on Skew Pencils traversing a Symmetrical Instrument.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—P. A. Spalding: Commercial Problems relating to the Application of Electricity from the Shannon Distribution System.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Essex Street), at 8.—Dr. C. W. Saleeby: Cancer Control via Birth Control Clinics.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.), at 8.15.—Dr. A. K. Gordon: The Rôle of the Spleen in the Causation of Hæmorrhage.

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY, at 8.30.—G. E. Bell: Constant Voltage High Tension Generators.—Dr. J. D. White: Abnormalities of the Bony Thorax.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. Parkes Weber: Note on the Association of Extensive Hæmangiomatous Nævi of Skin, with Cerebral (especially Meningeal) Hæmangiomata.—Dr. J. G. Greenfield: Measles Encephalitis.—Dr. R. M. Stewart: The Pseudo-polyneuritic Type of Amyotrophic Lateral Sclerosis.

INSTITUTION OF MECHANICAL ENGINEERS (Cardiff Branch).—Dr. H. W. Swift: Power Transmission by Belts: an Investigation of Fundamentals.

FRIDAY, DECEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—G. Shajn and O. Struve: On the Rotation of the Stars.—Prof. E. A. Milne: Ionisation in Stellar Atmospheres: Part II. Absolute Magnitude Effects.—H. Zanstra: The Excitation of Line and Band Spectra in Comets by Sunlight.—M. Minnaert: The Distribution of Energy near the Limb of the Sun.—C. Easton: A Photographic Chart of the Northern Milky Way.—J. Evershed: High Dispersion Prism Spectra.

BIOCHEMICAL SOCIETY (in Laboratories of J. Lyons and Co., Ltd., Hammersmith Road), at 5.—Prof. J. C. Drummond and L. C. Baker: Further Chemical Studies of the Vitamin A Fraction of Liver Oils.—B. Russell-Wells and Dr. P. Haas: The Hydrolysis of Carragheen Mucilage.—C. R. Harington: The Resolution of d, l-thyroxine.—M. W. Goldblatt: The Action of Insulin in Young Rabbits.—E. Clenshaw and I. Smedley Maclean: The Nature of the Unsaponifiable Matter from the Lipoids of Spinach and Cabbage Leaves.—L. H. Lampitt and P. Bilham: The Effect of Some Constituents of Milk on its Hydrogen Ion Concentration.—D. H. F. Clayson: The Diastatic Digestion of Raw Wheat Starch.—L. H. Lampitt and J. B. Bushill: Some Observations on the Determination of Surface Tension by the Ring Method, with Special Reference to Egg Albumin.—E. B. Hughes: Some Observations on the Production of Liesegang Rings.

IMPERIAL COLLEGE CHEMICAL SOCIETY, at 5.—H. L. Riley and others: Informal Discussion on The Problem of Molecular Structure.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting) (at Royal Westminster Ophthalmic Hospital), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. Ezer Griffiths: A Survey of Heat Conduction Problems (Lecture).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—E. G. Herbert: Machinability.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. H. Lockett: The Applications of Electricity in the Printing Industry.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—E. J. H. South: Locomotive Boiler Washing Plant.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Prof. W. A. Scott: Commercial Paper.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester), at 7.—Ll. B. Atkinson: How Electricity does Things (Faraday Lecture).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Municipal College, Burnley), at 7.15.—S. Stanworth: Comparison of English and French Moulding.

INSTITUTE OF METALS (Sheffield Local Section) (in Department of Applied Science, Sheffield University), at 7.30.—L. Wright: Chromium Plating.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—R. A. Bellwood: Present Day Methods of Oil Extraction.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. C. A. Robinson: The Treatment of Pelvic Inflammation by Diathermy.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group).—N. Swindin: The Air and Gas Lift as a Chemical Appliance.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section).—Prof. F. M. Rowe and Dr. C. P. Bean: The Effect of After-treatments on the Degree of Aggregation and Fastness Properties of Insoluble Azo Colours on the Fibre.

SATURDAY, DECEMBER 15.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Bayes: The Gulf between Painter and Public (II.).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—G. Mohn: The Application of the Microscope to the Study of Metals and Alloys.

PUBLIC LECTURES.

FRIDAY, DECEMBER 7.

KING'S COLLEGE, at 5.30.—Sidney Smith: Babylonian Amulets.

SATURDAY, DECEMBER 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—R. Aitken: Life and Tradition in the Spanish Rioja.

TUESDAY, DECEMBER 11.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Prof. G. Scott Robertson: The Use of Minerals in the Feeding of Poultry.

WEDNESDAY, DECEMBER 12.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. E. W. Hope: Industrial Diseases as viewed from the Standpoint of a Medical Officer of Health.

UNIVERSITY COLLEGE, at 5.30.—Dr. R. Offor: University Library Buildings.

CONFERENCE ON DRYING.

THURSDAY AND FRIDAY, DECEMBER 6 AND 7.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).

Friday, Dec. 7, at 10.30.—T. J. Horgan: Rotary Dryers.—G. W. Riley: Vacuum Drying.

At 2.30.—Dr. S. G. Barker: The Hygroscopic Nature of Textile Fibres.—B. J. Owen: The Drying of Agricultural Products.—A. C. Barnes: Some Drying Problems in Tropical Africa.

SATURDAY, DECEMBER 15, 1928.

CONTENTS.

Editorial and Publishing Offices :
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A Neglected Aspect of Scientific Research.

IT is unnecessary to stress the vital importance of research in the development of industry. It would be admitted generally that the intensive application of the scientific method is necessary in order that British manufactures may compete successfully with foreign goods and increasing exports lead to the mitigation of the terrible evil of present unemployment. Although the business application of economic laws is leading to the merging of commercial organisations with a view to the elimination of waste by unification of method, so far economic considerations have not been applied so extensively to scientific and technological research.

In Great Britain considerable attention has been given to the organisation of research, and large sums of money have been provided for its prosecution both by Government and private institutions and donors ; but it has been neglected to organise the bibliographical research which should precede every experimental investigation. The failure to study this problem from the economic point of view is the cause of more inefficiency than is generally realised, and the application of simple economic laws would lead to a corresponding gain.

The precise extent to which research workers are wasting energy in repeating experiments that have already been made is difficult to estimate ; but those who have given much attention to the study of the literature of their special subjects are aware that the proportion of labour which is wasted for lack of information on previous work is very high. It is indeed more than possible that half the energy expended in experimental research is dissipated in useless repetition. Perhaps it is less well perceived that the same proportion of useful work is published only to be buried out of sight in masses of volumes on the library shelves. To end this extravagance would increase enormously the efficiency of scientific research and the resulting stimulus to industry would be incalculable. It is worth while, therefore, that attention should be concentrated on the indexing of recorded information, so that hard-won data may be found at need and play their part as a basis for further progress.

A contribution to the solution of this problem was made at the Oxford conference of the Association of Special Libraries and Information Bureaux (ASLIB).[1] In the first place, it was suggested that

[1] The Association of Special Libraries and Information Bureaux. —— of Proceedings of the Fifth Conference held at New College, September 14-15, 1928. (London: ASLIB, 26 Bedford W.C.1.)

a record must be kept of every useful scientific fact discovered, that is, every important publication in which scientific or technological research is recorded, in whatever language, should be filed in a library from which the books may be borrowed as required ; and secondly, that every useful paper should be indexed.

When we consider what the second proposition involves, the figures are somewhat startling, but in attempting to measure research on a world scale, the million becomes the unit, as in rationalisation generally. Careful estimates show that each year more than a million useful scientific and technological articles are published, besides some thirteen thousand separate books on these subjects. At the same time, the energy of would-be bibliographers is so great that a comparable number of bibliographical entries are printed. This means that to index the total output of scientific and technical literature needs merely the co-ordination of the work of those who are now working independently making separate bibliographies, which are of limited value in the aggregate, on account of diversity of style and lack of method.

Thus the first step towards the production of a comprehensive index to recorded data is the co-ordination of bibliographical work by the standardisation of method ; and this can be done by the universal adoption of a single classification. It is suggested that individual bibliographers should agree to work together for the common good by using the same system. By so doing, each one would get a classification that embodies the accumulated experience of his co-workers, while his work would be made available for use by all and theirs by him. It is granted that a standard classification is required for the production of a great bibliography, such as the International Catalogue of Scientific Literature, for example. Conversely, if a large number of bibliographical undertakings and individuals should agree to use the same classification, their total bibliographical output would be unified immediately. An individual worker or institution would then be able to collect references on a special subject from all the standardised sources, and intercalate them in one series in a single special bibliography ; while very large libraries could form comprehensive indexes in which all such uniform entries would fall into place automatically, so that information needed could be found in a moment, with the saving of weeks or months of work at each consultation. Thus, by adopting a standard classification, the separate index entries, prepared by each individual, would fit into a single whole like the standardised parts of a machine and, as the total volume of bibliographical work is so great, the desired index to knowledge would be well on the way to achievement.

The scheme above outlined depends on the provision of a suitable classification, such as the Brussels extension of the Dewey decimal classification. At the ASLIB conference there appeared to be some confusion of thought between the Brussels extension and the original Dewey decimal classification. Considerable support to the proposed scheme was apparent in the discussion, though unfortunately one of the more helpful contributions seems to have been omitted from the report. On the other hand, there was a tendency to discuss the limitations of Dewey's scheme, or of other systems, rather than to point out any defects in that which was advocated, or to suggest an alternative to it. It was remarked, for example, that " The problem merged into that controversial question of the general librarian, ' classified ' catalogue versus ' dictionary ' catalogue," although, obviously, a dictionary system, in which each classifier chose his own subject headings, could not serve to co-ordinate the work of an army of bibliographers throughout the world. The same speaker observed that " librarians of general libraries did want something better than the present basic Dewey, if we were to avoid making individual adaptations." Another urged that the Library of Congress had rejected the Dewey code. Actually, of course, by virtue of its auxiliary signs and tables, and extended schedules, the Brussels classification is more comprehensive than the original Dewey scheme, although comprised within a single volume not a great deal larger than that of Dewey. Apparently no one ventured to suggest that the Library of Congress classification could be used as the basis of a comprehensive index.

As another speaker suggested, " The best line of action in standardisation was to take what had already been done and see where the general consensus of opinion lay. . . . We should see which method had been most universally applied and adhere to that one." If these considerations are to be the basis of the decision, then it would seem that the Brussels classification would be chosen. We believe the system has been used for classifying all kinds of literature on the largest scale for a quarter of a century, and by many scientific and business institutions in all parts of the world.

It seems clear, therefore, that an attempt should be made to unify bibliographical work in the way suggested, with the view of providing a comprehensive index to the world's work and so preventing

much of the wasted effort that now occurs. A good example has been set by the Optical Society, which prints with each part of its *Transactions* an index slip in which each entry bears the Brussels classification number at its top right-hand corner; and the Royal Photographic Society has added the classification numbers to *Photographic Abstracts*. Such entries can be cut up, mounted on cards, and intercalated in one series with all other bibliographical notices classified on the same system. Authors who contribute papers to such a society have the satisfaction of knowing that their work is indexed automatically in libraries where bibliographical notices are filed on the Brussels system, and is thus made available for all time whenever and by whomsoever it may be needed.

The X-Ray Microscope.

An Introduction to Crystal Analysis. By Sir William Bragg. Pp. vii + 168 + 8 plates. (London: G. Bell and Sons, Ltd., 1928.) 12*s*. net.

A NEW book from the pen of Sir William Bragg is always a noteworthy event. Before we open it we know that it is one which we have to read and one which it will be a joy to read. The latest is no exception. Based on and expanded from a series of lectures delivered at University College, Aberystwyth, it is intended, as its title implies, to introduce the general scientific reader to the method of the X-ray analysis of crystals. This method is no longer the monopoly of pure research laboratories, but is finding its way into the fields of applied science and is throwing light on many industrial processes. For this reason, if for no other, it is becoming more and more important that the scientific worker, no matter what his specialist line may be, should have a clear understanding of the principles of the method and some idea as to the possibilities of its application. Only so will he be able to gauge whether it has any aid to offer him in his own especial province. It is to such workers that this book is addressed, and that it will fulfil its purpose is beyond doubt. It is surprising how many aspects of the subject have been discussed in so small a volume, but the material is presented so clearly and with such skill that there is no sense of overcrowding.

The first chapter is devoted to an explanation of how the combination of the X-rays and the regular atomic arrangements characterising the crystal give rise to diffraction effects the interpretation of which afford an insight into the nature and details of these arrangements. Sir William Bragg then proceeds to explain the various experimental methods at present in use. In this connexion his treatment of the method of the rotating crystal is peculiarly attractive, and those readers who have read other accounts will appreciate its directness and simplicity.

Having laid down the principles and given an account of the actual experimental procedure, the author goes on to describe the results obtained by their application to some inorganic substances. Each example is carefully chosen so as to bring out some aspect of importance and emphasise some line of argument. These relatively simple examples serve to illustrate the main characteristics of the various crystal arrangements and to lead naturally to the next section, which deals with more general considerations developed by the older crystallographers, in particular with the theory of space groups. Federov and, independently, other workers showed that there is only a limited number of possible arrangements of atoms and groups of atoms, 230 in all. This classification had little save a theoretical interest until the advent of X-ray methods. The older crystallographer, dependent as he was on the observation of external features, could place his crystal in one or other of 32 classes, but he knew that it should be possible to make the division a finer one and choose from 230 space groups the one to which his substance belonged. Sir William Bragg shows us how these groups naturally arise, and, further, how and why X-rays can differentiate between them. No one who has studied the subject can fail to appreciate what a triumph of exposition this chapter represents.

The next chapter returns to more practical applications, and here we find a description of some work on rather more complicated substances which have been studied of recent years. The full interpretation of the X-ray results in these cases presents many difficulties, but this account shows us that steady progress is being made and that we are learning, step by step, to read the message conveyed by these diffraction patterns. The incompleteness of the solutions is not due to any inherent weakness of the method, but rather to our comparative inexperience in handling it.

In the final chapter we are brought back again to the study of simpler structures, those of the metals, in order that other and more immediately practical aspects of the work may be presented. The X-ray method is peculiarly suitable for the study of the different phases of alloy systems and for the investigation of the changes in the structure of a metal when it undergoes any cold working process such as drawing or rolling. Those who have to deal with such problems have not been slow to realise the

value of what is really a new and immensely powerful microscope.

We said that the book was intended for the general reader, but we can equally commend it to the specialist, not that there is much danger of his leaving unread anything Sir William Bragg has to say. Deep immersion in any subject tends to restrict that breadth of vision so necessary to progress; the wood cannot be seen for the trees. There has perhaps been a tendency for certain workers to rest content when they have assigned a substance to its particular space group. It is emphasised here that this is only one step, and not necessarily a very important one. The main object is the application of the new information which the method yields towards a better understanding of the physical and chemical properties of solids. The title does not really do justice to the book. It does more than introduce the reader to the subject: it presents him with an invaluable and exceedingly interesting account of a method which is rapidly becoming more and more extensively used in the fields of pure and applied research. The world of science owes Sir William Bragg one more debt on top of a list which is already indeed a long one.

The Power from Niagara Falls.

Niagara Power: History of the Niagara Falls Power Company, 1886–1918; Evolution of its Central Power Station and Alternating Current System. By Dr. Edward Dean Adams. (Privately printed for the Niagara Power Falls Company on the Fiftieth Anniversary of its Foundation, 1927.) In 2 volumes. Vol. 1: History and Power Projects. Pp. xxii + 455. Vol. 2: Construction and Operation. Pp. xv + 504. (Niagara Falls, N.Y.: Niagara Falls Power Co., 1928.) n.p.

IN these two volumes many historical details and documents in connexion with Niagara Falls are given. There are also several historical pictures of the Falls, the earliest dating from 1678. Proofs are given of the story that on Mar. 31, 1848, the great Niagara River nearly ran dry. The waters had receded so much that the bed of the river was exposed to view. The Welland River, which runs into the Niagara, was practically dry, and a number of old gun barrels were found in it, which were doubtless thrown into the river during the war of 1812.

The theory of this phenomenon, commonly accepted, is that the wind had been blowing down Lake Erie, which is only about 80 feet deep, and had rushed a great deal of the water from it over the Falls. It may then have suddenly changed and blown the small amount of water left up to the western portion of the lake. It is known that the ice on Lake Erie, probably broken up by these high winds, got jammed in the river between Buffalo and the Canadian side, forming a dam which kept back the waters of Lake Erie for a whole day. This sudden occurrence greatly frightened the natives, who thought that something terrible was going to happen.

It is known that the rim of the horseshoe fall at Niagara is wearing backwards at the rate of about five feet per annum. This fall is the principal division of the cataract. The surging water wears away the shale and deprives the limestone bed of its support. From time to time blocks of limestone break away and fall into the pool below, thus lengthening the gorge. Between 1842 and 1891 the cataract retreated and the gorge lengthened by 200 feet. On the other hand, the American fall has not changed in position or form appreciably since 1827.

The main purpose of these volumes, however, is to give the history of the rise and development of the Niagara Falls Company for the benefit of the stockholders. This company has made its mark on the industry and commerce of the United States, and its methods of generating and transmitting electricity have been closely studied by engineers all over the world. The story of Niagara power in the early nineties of last century is the story of a strenuous and successful endeavour to utilise the power then running to waste. The Cataract Construction Company was formed in June 1889. The author, Dr. E. D. Adams, was appointed the first president of the company, and is now the only surviving director.

In 1890 there were already several large electric machines at work in Europe. Siemens and Halske of Berlin, and Ganz and Co. of Budapest, had each successfully made a 750 kilowatt direct current generator. The Oerlikon Company of Zurich had built a 450 kilowatt direct current generator for use in an aluminium works, and Messrs. Escher, Wyss and Co. of the same city had constructed fourteen water turbines of 1000 horse-power each for their power station at Rheinfelden. Deprez had transmitted 80 horse-power from Bourganeuf to Paris, a distance of about 10 miles, in 1889, and the Oerlikon Works had transmitted 300 horse-power from Lauffen to Frankfort in 1890. Notwithstanding these successful applications of electricity, it is almost startling to read that power

experts in 1890 were divided in their opinions as to whether cable and rope, water pressure, compressed air, or electricity should be used. Many were strongly in favour of compressed air.

In order to get the best scientific and engineering knowledge, the Cataract Company decided to form an 'International Niagara Commission.' The president of the Commission was Sir William Thomson (afterwards Lord Kelvin), and the other members were Prof. Sellers of the Stevens Institute, Prof. Mascart of Paris, Colonel Turrettini of Geneva, and Prof. Cawthorne Unwin, who also acted as secretary of the Commission. The numbers of the Commission were finally increased to thirty-three. Some of them visited the electrical station at Deptford, which transmitted power at 10,000 volts to the sub-station at Trafalgar Square. They were favourably impressed by Ferranti's methods. They offered prizes for the best schemes for utilising the power at Niagara, but the amounts of the prizes and bonuses offered, namely, £200 and £100, do not now sound excessive. There is still to be seen in the salon, called the Niagara Room, of Brown's Hotel, London, a brass plaque commemorating the epoch-making services rendered by the International Commission. It states that the Commission publicly announced its opinion in favour of the adoption of electrical methods of power transmission. In its report, however, the Commission states that other subsidiary methods may be useful. The Commission ended by Sir William Thomson entertaining his colleagues at dinner at the Whitehall Club.

By 1900 the principal works were completed, and ten alternators, each of 5000 horse-power, were in service. In this year the Cataract Company surrendered its rights to the Niagara Falls Company. In 1904 the second power-house was constructed, and in 1906 Canadian plant, having an output of about 50,000 horse-power, was put into operation. The total installed capacity in 1926 amounted to about 680,000 horse-power.

Many diagrams are given illustrating the gradual evolution of the transmission lines and poles from Niagara to Buffalo. The development of Niagara power in 1895 gave an immense impetus to the development of the use of electric furnaces. The economic importance of aluminium, calcium carbide, abrasives, ferro-alloys, silicon, and graphite is now recognised in commerce. Willson, the inventor of calcium carbide, worked with a 200 horse-power furnace. At the present time there are furnaces at Niagara making as much carbide in a day as Willson's furnace produced in a year.

A. R.

Medieval Winters.

Les hivers dans l'Europe occidentale : étude statistique et historique sur leur température, discussion des observations thermométriques 1852–1916 et 1757–1851, tableaux comparatifs, classification des hivers 1205–1916, notices historiques sur les hivers remarquables, bibliographie. Par Dr. C. Easton. Pp. iv + 210. (Leyde : E. J. Brill, 1928.) n.p.

IN the *Proceedings of the Royal Academy of Science of Amsterdam* for 1918, Dr. C. Easton published a paper on "Periodicity of Winter Temperatures in Western Europe," in which he gave the results of his analysis of a long series of historic records, but not the records themselves. He has now, at the instance of Dr. J. P. van der Stok, published the materials on which his study was based, and one can appreciate both the difficulties he encountered and his ingenuity in overcoming them. Having accomplished the enormous amount of reading, in several different languages, necessary to make a thorough collection of ancient records, he had not only to estimate the relative severity of the various winters recorded by the chroniclers, but also to compare them with the winters of recent years for which instrumental records are available.

In the absence of instrumental observations, what characteristic of a winter is most likely to impress contemporary writers and cause them to record it as severe? Evidently it is not alone the mean temperature of the three months December, January, and February, for some winters which are remembered because of a short spell of Arctic cold have also had compensating spells of warmth, and the mean temperature has been not far from normal. Moreover, in some years the lowest temperatures occur in November or March, outside the true winter season, and yet leave behind them the impression of a severe winter. In western Europe, on the borderline between frost and thaw, the number of days of frost, and the number of days without thaw, are both of considerable importance. Taking all these points into consideration, Dr. Easton evolves a method of tabulation in which, from instrumental observations at nine stations ranging from Greenwich to Strasbourg and Bremen to Lyons, he measures the mildness of the winters from 1852 to 1916 by means of a 'coefficient of temperature' on a scale of 0 to 100, low numbers signifying severe winters and high numbers mild winters. Mean temperature of the three winter months is regarded as the most important element, but days of frost, days without thaw, and very cold days (below 14° F.)

also contribute to the result, while the possibility of a prolonged cold season is allowed for by taking the mean of the three lowest minima in different months from November to March. To secure comparable results, each of these elements is expressed in terms of its standard deviation.

From 1757 to 1851 less complete instrumental observations are available for fewer stations, but it is still possible to estimate the intensity of the different winters in much the same way. Before 1757, however, instrumental observations are completely lacking, and only the more or less vague descriptions of the chroniclers are available. Before 1205 even these records become too scanty to be of value, but it was necessary to find some method of applying the coefficient of temperature evolved for the instrumental period to the 552 non-instrumental winters from 1205 to 1756.

The first step, that of arranging the various winters in order of severity, called for delicate judgment, and another assessor would certainly arrive at a different result, but no doubt the arrangement is sufficiently accurate along its main lines. The winter which is adjudged most severe is that of 1407–8, but the winter of 1607–8, "which lasted a year," also has strong claims to pre-eminence. In order to effect the comparison with the instrumental years, the author assumes that the climate of western Europe has not changed appreciably since 1200. Whatever we may think of the truth of this assumption, it was obviously necessary for the purpose. The corollary of this was that the distribution of winters of different degrees of intensity from 1205 to 1756 was similar to the distribution from 1757 to 1916. Since the latter period contains one season (1829–30) sufficiently severe to be classified as a 'great winter,' the former period would be expected to contain four such winters. Actually five 'great winters' are recognised, ending in the years 1408, 1608, 1565, 1709, and 1435, and these are all given the coefficient of temperature measured for 1830, namely, 4. In the same way 12 winters are classified as 'very rigorous' and given the coefficient 10. The disadvantage of this method is that while 1435 was little more intense than 1306, the former receives the coefficient 4, the latter 10. Having decided on the order of severity, it would have been more consistent to grade the numbers, but grading would have given an illusion of exactness which the author no doubt wished to avoid.

Estimates of this nature cannot take the place of instrumental observations, and are easy to criticise, but they have a real value in extending the range of data for such studies as the author's investigations into periodicity. They are also of value because they require, and insist on, a conservative instead of a sensational view of the weather of former centuries. Quite apart from the estimates and calculations, however, the book is to be welcomed for its wealth of historical data extending back to 396 B.C., with full quotations and exact documentation, and critical notes, a mine of reference for historical studies.

C. E. P. B.

Prehistoric Industries and Art in South Africa.

South Africa's Past in Stone and Paint. By M. C. Burkitt. Pp. xiv + 183 + 9 plates. (Cambridge: At the University Press, 1928.) 12*s.* 6*d.* net.

MR. BURKITT feels a difficulty in catering on one hand for the needs of South Africans, who naturally are interested in tracing the connexions of their local finds with the archæology of the northern hemisphere, and, on the other hand, to bring to the notice of European prehistorians the very considerable amount of investigation that has already been done in South Africa. As a matter of fact he has succeeded in doing both in an admirable manner. He has given a clear synopsis of the main stone industries of South Africa, with brief but sufficient descriptions of the various types of tools, that certainly will give the European archæologist a just conception of the whole subject, and one can well believe that South African students will find it equally valuable; Mr. Burkitt pays a well-deserved tribute of appreciation to the work done by these local archæologists.

The artefacts fall into several main groups: those of older palæolithic type are of the Victoria West, Stellenbosch, and Fauresmith industries. The last appears to have been influenced by a culture corresponding to the middle palæolithic or Mousterian phase. This influence is well marked in the industry from Glengrey Falls and that at Yardley, but by this time neanthropic man had reached South Africa. The Still Bay culture shows the passage from a typical 'Mousterian point' to a kind of 'laurel-leaf point' which is very 'Solutrean' in character. A similar evolution has been detected by Mr. Leakey in Kenya, and can also be seen in North Africa in an area where in all probability Mousterian man was in contact with Capsian man. Mr. Burkitt suggests that perhaps a similar contact between Neanthropic and Middle Palæolithic cultures occurred also in Hungary, "the cradle of the true Solutrean culture." The Wilton culture is definitely neanthropic and is a characteristic

'pigmy' industry. The Smithfield culture consists of an older and a newer industry, the latter apparently persisting into recent historic times. Finally, there are the kitchen-midden industries; these belong on the whole to the Wilton culture, though there is evidence that other peoples besides the Bushman took to a strand-looping life.

The most original part of this excellent book deals with rock-paintings, in which Mr. Burkitt has been able to establish a sequence provided by superpositions and marked by the use of distinctive pigments and notable differences in style. In Southern Rhodesia he distinguishes five different age periods, which may perhaps be resolved into three. In the Orange Free State Province several series of art styles were determined. The types of paintings of this Central Art Group are much more varied than those of Southern Rhodesia, and whenever industries have been found associated with these paintings, they can be referred to the Upper Smithfield culture. The paintings of the Southern Art Group are quite dissimilar and far inferior to those of the Central Group; all are executed in red pigment and are associated with the Wilton, that is, the Bushman, culture.

A visit was paid to Zimbabwe, and Mr. Burkitt noticed Kaffir hearths extending below one of the walls of the acropolis; he thinks it reasonable to suggest some date between A.D. 1000 and A.D. 1200 for the construction and use of these monuments.

Mr. Burkitt has written a very useful and attractive book. He was accompanied by his wife in all his expeditions, some of which were distinctly arduous. The book is well illustrated with photographs, and a large number of very good drawings of implements by Mrs. Burkitt, who also made a large series of tracings of the rock paintings. The coloured plate drawn by her explains the colour terminology and sequence.

A. C. Haddon.

Our Bookshelf.

Physics for Medical Students. By Prof. Sidney Russ. Pp. vii + 230. (Edinburgh: E. and S. Livingstone, 1928.) 10*s*. 6*d*. net.

One of the important problems that come before the teacher of physics is that of the instruction of medical students in this subject. The problem is a difficult one, because the student often shows a distaste for the subject, and it is obvious that his aim is to pass an examination which will open a door to freedom from physics. There are many text-books for medical students, but most of them are written merely for examination purposes and are not satisfactory even in this respect. Few are designed to interest the future medical practitioner in principles of wide application in medicine, surgery, and gynæcology. Dr. Russ's book is valuable, in that it is worthy of its title and rouses the interest by pointing continually to the application of physical principles in medicine and to their use in diagnosis and treatment.

The book is short and covers the essential points of importance in examinations, but it is not written with the sole object of pandering to a syllabus; it suggests, indeed, the type of syllabus appropriate to the medical student, and the field from which examination questions might profitably be chosen.

The author has had considerable experience in the teaching of medical students, and has also an intimate knowledge of the details of the application of physics to medicine. This is well exemplified in the chapter on X-rays and radioactivity, where we find useful facts stated and duly stressed, as, for example, the mention of radon and its place in the series of radioactive elements.

It is easy to understand why the author deals only briefly with the subject of sound, but his object would have been helped by a short account of the mechanism of hearing.

The diagrams are good, simple, and easy to follow. A mistake has been overlooked in Fig. 73, where the division of the rays has been shown to take place within the prism and not on emergence. The same point is illustrated correctly in Fig. 77.

Der fossile Mensch: Grundzüge einer Paläanthropologie. Von Prof. Dr. E. Werth. Teil 3 (Schluss der Werkes). Pp. xi + 577-898. (Berlin: Gebrüder Borntraeger, 1928.) 30 gold marks.

In this concluding part of his treatise Prof. Werth deals with man himself, and questions of climate, industries, and associated fauna. It is generously and clearly illustrated.

The ground covered in the present volume has been so repeatedly surveyed by hosts of writers during the last decade, that it is unnecessary to say more of the parts of the book dealing with matters concerning which there is general agreement beyond the statement that the work is done well.

Turning to the contentious issues, the author still believes that the Piltdown jaw is an ape's, and thinks the cranium is not sufficiently different from that of modern man to warrant the creation of a new genus for its reception. His idea of the relationships and phylogeny of the Primate groups is distinctly novel. He suggests that *Propliopithecus* and *Parapithecus* were derived from the Lemuroidea. From the former emerged the Miocene *Dryopithecus*, whose Pliocene descendant *Palæopithecus* was the ancestor of the orang, the chimpanzee, and the gorilla. The Oligocene *Parapithecus*, on the other hand, was the ancestor of two phyla, one leading (through *Pliopithecus*) to the gibbons, the other (through *Pliohylobates*) to the human family.

This is a very strange variation of the many

recent attempts to evade recognition of our relationship to the giant apes. The admission of the real affinities of the Piltdown man would make the adoption of such a scheme of human ancestry impossible.

The Journal of the Institute of Metals. Vol. 39. Edited by G. Shaw Scott. Pp. xii + 814 + 63 plates. (London: Institute of Metals, 1928.) 31*s.* 6*d.* net.

THE president's address, with which the present volume opens, is devoted to the subject of the 'thermal equilibrium diagram,' in order to show that such diagrams, which may appear to be of merely academic interest, have great practical value for the foundryman and the worker in metals. Several alloy systems are described in illustration, and a further example is afforded by a paper describing the changes in standard silver which are brought about by heat treatment. It is of interest that this alloy may be made to develop structures which under the microscope closely resemble those of hardened steel by quenching under different conditions. Several systems of alloys containing that very reactive metal, zirconium, have been prepared with the aid of a high-frequency induction furnace working in a high vacuum, but owing to the very limited range of solid solubility of the intermetallic compounds which are formed, the alloys do not promise to be of technical value.

Other papers deal with hot and cold working, and an investigation which has great practical consequences has now been published, dealing with the deterioration of lead cable sheathing by cracking. The difficulty is found to be due to the low fatigue limit of lead, and it has been overcome by alloying with cadmium and either tin or antimony. The May lecture has as its subject the chemical properties of crystals, and the volume contains the usual extensive section of abstracts, the net having been cast so wide that few papers of interest to metallurgists can have escaped inclusion.

Einführung in die theoretische Physik. Von Prof. Dr. Max Planck. Band 4: *Einführung in die theoretische Optik; zum Gebrauch bei Vorträgen, sowie zum Selbstunterricht.* Pp. vii + 184. (Leipzig: S. Hirzel, 1927.) 6 gold marks.

THIS "Introduction to Theoretical Optics" concludes appropriately the series of four volumes on "Theoretical Physics" by Dr. Max Planck. General mechanics, the mechanics of deformable bodies, and the theory of electricity and magnetism are the subjects of the three earlier volumes.

According to the author, his object has been to present and interpret, chiefly by word, the more important general principles, rather than to elucidate them mathematically. Fundamental formulæ have necessarily been freely employed. Space, however, has not been sacrificed to their development. From the large amount of material available, only a limited selection has been possible. The treatment is based almost entirely upon the electromagnetic wave theory. It is only in the last chapter, devoted to the geometrical optics of non-homogeneous bodies, and particularly to dispersion, that use is made of quanta mechanics or the principles of relativity.

The discussion of the optical questions dealt with is simple and lucid. The book will certainly appeal not only to the lecturers and students for whom it is intended, but also to a much wider circle of general scientific readers. J. W. F.

Der Werdegang einer Eruptivmasse: Geologisch-petrographische Analyse der Intrusionstektonik im Schwarzwalde. Von S. von Bubnoff. (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 7, Heft 20.) Pp. viii + 239 + 6 Tafeln. (Berlin: Gebrüder Borntraeger, 1928.) 20 gold marks.

PROF. SERGIUS VON BUBNOFF is well known, especially from his "Geology of Europe." In this monograph he gives a detailed account of the south-western margin of the Black Forest, with special reference to its contact phenomena and intrusion-tectonics, a term familiar from its use by Prof. F. E. Suess for the mountains to the east. Prof. von Bubnoff holds that the schists and gneiss of the Black Forest are older than the granitic intrusions. He rejects the view that the metamorphic rocks were formed in Upper Palæozoic times, and expresses doubts as to this age for those in the Variscan Mountains. The book is illustrated with excellent maps and plates, and is an important contribution to the geology of south-western Germany.

The Philosophical Bases of Education. By Dr. Robert R. Rusk. Pp. 205. (London: University of London Press, Ltd., 1928.) 5*s.* net.

THE title of this book would have been better chosen as the "Idealistic Philosophical Basis of Education." The author has no particular use for either the naturalistic or pragmatic philosophies, and concentrates all his attention on idealism. He gives quite a good account of naturalism and pragmatism in education, with his bias towards idealism showing through, and then presents the case from the idealistic point of view. The book is well written and the subject matter well arranged. The author's account of the historical development of idealism from the days of Socrates, through Rousseau, Kant, and Fichte, to the modern idealism, is good.

Temperament: a Survey of Psychological Theories. By Constance Bloor. Pp. iv + 202. (London: Methuen and Co., Ltd., 1928.) 5*s.* net.

IN this book the author has made a brave attempt to solve the various problems presented by a consideration of the word temperament. After a discussion of the various contributions made by the older writers, we are introduced to five temperaments, the sanguine, the choleric, the phlegmatic, the melancholic, and the cautious. The author appears to be impressed by the physiological basis of temperaments provided by the glands of internal secretion and by their inter-relationship with the sympathetic and para-sympathetic nervous systems. Probably time will show that this is the correct view to be taken.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Frequency Change in Scattered Light.

WORK has been carried out in this laboratory on the frequency change in scattered light (Raman effect), using a plane polarised beam. The preliminary results seem sufficiently interesting to be worth publishing even in an incomplete form. With carbon tetrachloride and an unpolarised beam, it is found that the modified lines of wave-lengths 4400 A., 4419 A., and 4447 A., produced by subtracting the quanta corresponding to the infra-red wave-lengths 46μ, 32μ, and 22μ from the violet mercury line 4358 A., are all about equally strong. If the exciting light is plane polarised, the line 4447 A. is missing when the scattered light is examined in the plane of polarisation of the incident light, but appears with about twice the intensity of the other two when observed in a direction at right angles to it.

The only explanation of this phenomenon which suggests itself, couched in terms of the classical theory, would seem to be that the oscillation giving rise to the modified line at 4447 A. is linear, whereas the other two are not. If one assumes that a polarised quantum can only interact with a linear oscillator if the plane of polarisation is perpendicular to the line in which oscillation occurs and that it is re-radiated polarised parallel to this line, it is clear that the above result would be observed.

This explanation is of course only tentative. The exact intensity ratios are being determined, and work on other liquids with unsymmetrical molecules as well as on crystals is proceeding which will, it is hoped, throw further light on this interesting phenomenon.

F. A. LINDEMANN.
T. C. KEELEY.
N. R. HALL.

Clarendon Laboratory, Oxford,
Nov. 28.

The Ultra-Violet Light of the Sun as the Origin of Auroræ and Magnetic Storms.

THE novel theory of auroræ and magnetic storms described by H. B. Maris and E. O. Hulburt (NATURE, Nov. 24) cannot be examined in detail until their promised paper appears, but some of its principal features induce me to believe that the true explanation of these phenomena must be sought along different lines.

The theory supposes that occasional sudden blasts of ultra-violet light are responsible for auroræ and magnetic storms. The terrestrial effects would be almost immediately felt, and would depend relatively little upon the position of the emitting area on the sun's disc; unless, indeed, the area were in a hollow on the sun, it would be not less than about half as effective if 60° from the centre of the disc as at the centre.

These consequences appear incompatible with the marked tendency for abnormal terrestrial magnetic conditions to recur after about 27 days, which is the rotation period of the sunspot zone relative to the earth. The arguments based on this recurrence-tendency by E. W. Maunder in 1905 remain valid in demonstrating that magnetic storms are caused by something that travels outwards from particular disturbed areas on the sun in laterally limited beams; it must therefore almost certainly be corpuscular. It affects the earth only when the stream comes near the earth, and though the stream may be intermittent, its emission must be in progress for a much larger fraction of the time than that during which it is effective in producing magnetic disturbance. Evidence is accumulating to indicate that the material of the stream occupies a time of the order of a day in passing from the sun to the earth. It therefore seems that in proposing ultra-violet radiation, in merely contemporaneous excess, as the cause of magnetic storms, the theory starts from a false major premise.

Apart from this fundamental objection, the proposed explanations of the two phases of a magnetic storm seem doubtful. The eastward 'drift-current' (to use the term introduced in my letter to NATURE of Oct. 13, 1928), to which the authors attribute the initial increase of horizontal magnetic force, would affect the sunlit and dark hemispheres very unequally, contrary to usual observation in a magnetic storm; in my opinion, variations in the intensity of ultra-violet radiation are associated with changes in the solar diurnal magnetic variation of quiet-day type, instead of with magnetic disturbance.

In the second, and principal, phase of a magnetic storm, the horizontal magnetic force is decreased, and the authors ascribe this to diamagnetism in the auroral zones, due to the spiral motion of ions then present there in unusual number. When R. Gunn's recent interesting diamagnetic theory of the solar diurnal magnetic variation appeared (*Physical Review*, July 1928), I examined the nature of the field of a strongly diamagnetic auroral zone, and concluded that it would differ in important respects from the magnetic disturbance field. But should the authors' radically different conclusion be correct, and the diamagnetic field be qualitatively in accord with observation, it would still seem that the diamagnetism of the spiralling charges in the auroral zone would be of minor importance compared with the effect of the drift currents in this zone.

I hope shortly to publish a new discussion of the theory of magnetic disturbance, assuming the cause to be a neutral ionised stream (as suggested by F. A. Lindemann, *Phil. Mag.*, 38, 669; 1919). In this connexion Mr. V. C. A. Ferraro and I have extended, and partly corrected, my investigation (*Camb. Phil. Soc.*, 21, 577; 1923) of the motion of such a stream in the earth's magnetic field. In view of the past history of terrestrial magnetic theory, it would be too much to anticipate that this new discussion will avoid cause for criticism, but, in this difficult field, criticism and speculation are both necessary. I regret, however, that my criticism of the theory proposed by Mr. Maris and Mr. Hulburt must be of so root-and-branch a character.

S. CHAPMAN.

Imperial College of Science and Technology,
South Kensington, S.W.7, Nov. 28.

Phosphate Content and Hydrogen Ion Concentration of the Surface Water of the English Channel and Southern North Sea, June 18–22, 1928.

ATKINS, who has carried out numerous analyses of the phosphate content of the English Channel, has found that water containing 30 to 40 milligrams of P_2O_5 per cubic metre in the winter is almost completely devoid of phosphate in the early summer owing to its utilisation by algæ. The depletion occurs first in the upper layers in the spring, when

the sunshine begins to exceed about three hours a day. The time varies, and a comparison of one year with another has shown that the main differences are due to the dates when the phytoplankton multiply rapidly and use up the phosphate at a greater rate than it is being re-formed from dead organisms (Harvey, 1928).

Likewise, a rapid multiplication of the phytoplankton crop in an area will lower the amount of carbon dioxide in the water, causing a decrease in the concentration of hydrogen ions (the *p*H value will be raised). Thus, in the surface water of the English Channel a lowered *p*H value is associated with a high phosphate content in the winter, and a high *p*H value with a low phosphate content in the spring and summer.

During the present cruise of the *Carnegie*, on the trip from Plymouth, England, to Hamburg, Germany, a number of surface samples from the English Channel and southern North Sea were collected and analysed for phosphate, hydrogen ion concentration, and salinity. The phosphate analyses were made by the colorimetric method of Denigès (Atkins, 1928), the salinity by the method of Knudsen, and the hydrogen ion concentration by the method of Barnett and Barnett (1921).

The hydrogen ion concentrations are expressed as *p*H. The indicator used for these determinations was cresol red, and the values have been corrected for salt error. The salt-error correction has been adopted from Ramage and Miller (1925), who, using cresol-red indicator and Clark and Lub's borate standards,[1] have studied the depression of the hydrogen ion concentration caused by salinities of 5 to 35 parts per thousand and give a correction of -0.27 to be applied to colorimetric *p*H measurements made on ocean water lying between 32 and 35 per mille salinity.

Data were obtained during June 18 to 22, 1928, at stations 1 to 13 located in the English Channel, stations 14 to 18 in the Straits of Dover, and stations 19 to 32 in the southern North Sea. Station 33 is in the mouth of the Elbe River.

The general low phosphate values of the surface water of the English Channel (except for stations 5, 6, and 7) direct attention to the fact that the phosphate in the upper water layers is being utilised by the phytoplankton at a greater rate than it can be replenished. The high values of phosphate recorded for stations 5, 6, and 7 may perhaps be due to local enrichment by ships, upwelling of the bottom water, or by drainage from the adjacent land. The average phosphate content of the surface water of the English Channel over the route followed by the *Carnegie* (exclusive of stations 5, 6, and 7), is 8·64 milligrams P_2O_5 per cubic metre. The average hydrogen ion concentration expressed as *p*H and corrected for salt error is 8·03.

The phosphate values recorded for the southern North Sea are lower than those of the English Channel, the surface water in this case being almost completely devoid of phosphate. The average phosphate content of the North Sea stations was 3·44 milligrams P_2O_5 per cubic metre, and the average hydrogen ion concentration expressed as *p*H and corrected for salt error, 8·11.

The records for the surface water of the Straits of Dover show phosphate values closely approximating those recorded for the North Sea. The average P_2O_5 content of the five stations in this locality was 3·65 milligrams per cubic metre, and the average hydrogen ion concentration expressed as *p*H and corrected for salt error, 8·05.

[1] Clark and Lub's borate standards are used to calibrate the instrument in use in this laboratory.

Comparing the above values of phosphate and hydrogen ion concentration for the English Channel and southern North Sea, it would seem that for the period of observations, June 18–22, 1928, there was a greater photosynthetic activity in the surface water of the southern North Sea than in the English Channel. The variation in temperature for the whole series of stations was not more than 1·2°. The average temperature of the English Channel stations was 12·8° C. and of the North Sea stations 12·9° C.

The mean latitude of the group of stations in the English Channel is 50° 26′ north; in the Straits of Dover, 51° 02′ north; and for those in the North Sea, 52° 34′ north. Thus, the mean difference in daylight (sunrise to sunset) between the stations of the English Channel and North Sea for the mean epoch of observations, June 20, 1928, was 24 minutes, the North Sea group having approximately 3 per cent longer

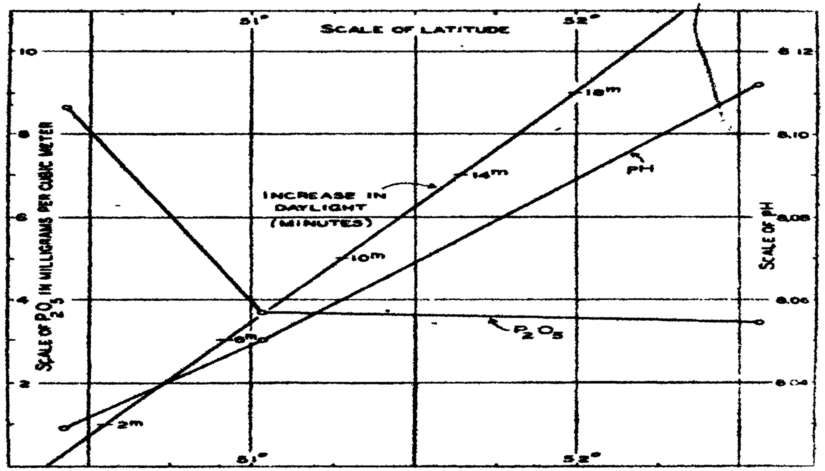

FIG. 1.

period of daylight. Therefore, other conditions being equal, we should for this period expect an increased amount of plant growth and reproduction for the North Sea group which would lower the phosphate content and hydrogen ion concentration in the upper water layers.

Fig. 1 illustrates the relation between P_2O_5 content, hydrogen ion concentration, and change in daylight-interval for the groups of stations in the English Channel, Straits of Dover, and North Sea during the period of observation. The average of the data for each of these groups is plotted against the mean latitude of each group.

H. R. SEIWELL
(Biologist and Chemist on board the *Carnegie*).

Carnegie Institution of Washington.

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The Stratosphere over North India.

ASCENTS of sounding balloons carrying Dines meteorographs carried out from the Upper Air Observatory, Agra, during the last two and a half years have yielded interesting information regarding the height and temperature of the base of the stratosphere over northern India and their remarkable seasonal variations. A brief summary of the results may be of interest to readers of NATURE.

All the three types of transition from the troposphere to stratosphere classified by W. H. Dines, namely—

Type I—When the stratosphere commences with an inversion;

Type II—When the stratosphere begins with an abrupt transition to a temperature gradient below 2° C. per kilometre without inversion; and

Type III—When the decrease of lapse-rate takes place gradually;

are met with. In addition, a fourth composite type with I above II or III is common between the months November to April.

During the period April 1926 to March 1928, 46 records of ascents going up to the stratosphere are available. The mean height of the tropopause (H_c) is 15·9 geodynamic or 16·3 ordinary kilometres and the mean temperature (T_c) 199° A.

In Fig. 1 are plotted the heights and temperatures of

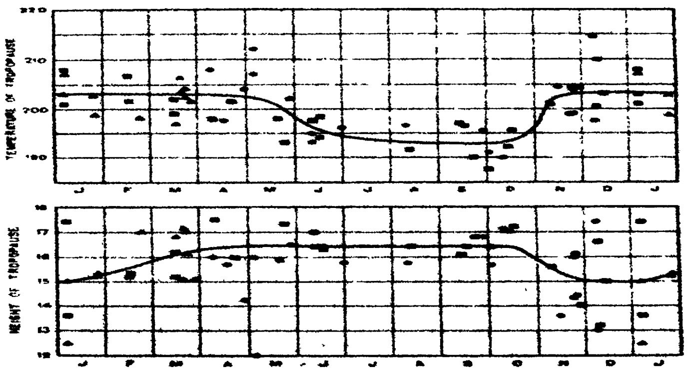

FIG. 1.—Variation of the height and temperature of the tropopause over Agra during the year.
●, Observations in 1926.
■, " " 1927.
▲, " " 1928.
Total Number of Observations, 46.

the tropopause obtained from the records of these ascents. When the transition is of the composite type, both positions of rapid changes of lapse-rate are plotted. The sudden jump of temperature and height of tropopause between October and November is specially noteworthy, as it occurs more than a month and a half later than the time of withdrawal of the monsoon from north India. From the point of view of seasonal variation, we may divide the year broadly into two parts:—

(1) *Middle of May to end of October.*—During this period, the type of tropopause is either I or II; if II, the initial sudden change of lapse-rate is followed by an inversion soon after, so that there is always an inversion of temperature in the stratosphere. The mean value of the height of the tropopause is 16·5 geodynamic kilometres, and its mean temperature 194·5° A. The period of activity of the monsoon in northern India is July to September.

(2) *November to middle of May.*—In this period, types III and IV are more frequent. Even here there is almost always an inversion of temperature above 17 geodynamic kilometres. The mean values of H_c and T_c during this period are 16·2 gkm. and 201° A. if we take the values corresponding to the higher value of H_c on occasions when the transitions were of type IV, and 14·9 gkm. and 203·5° A. if we take values corresponding to the lower values of H_c.

A significant feature shown by the results of the monsoon period is the comparatively high temperature

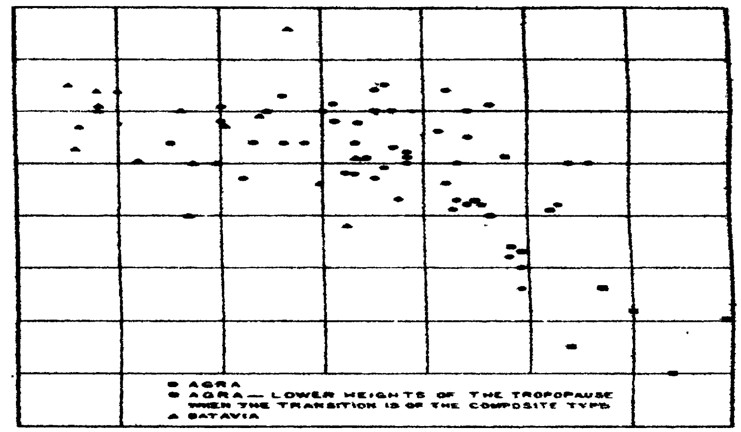

FIG. 2.

between 4 and 13 gkm. and the close agreement of the height-temperature lines between these limits with those of saturation adiabatics.

In Fig. 2 are shown the values of T_c plotted against the corresponding values of H_c. The values obtained by Bemmelen from ascents at Batavia are also plotted for comparison. The general tendency of H_c to approach a limiting value of about 17·5 gkm. with decreasing T_c is very suggestive.

K. R. RAMANATHAN.

Meteorological Office,
Poona, Oct. 12.

The Velocity Coefficient of a Homogeneous Bimolecular Gas Reaction.

THE theory of kinetic activation has been shown by Hinshelwood to lead to a simple explanation of homogeneous bimolecular reactions ("Kinetics of Chemical Change in Gaseous Systems," Oxf. Univ. Press). According to this view, two molecules react on collision when their joint kinetic energy at impact exceeds a certain limiting value E, termed the critical increment for the reaction. The number of binary impacts of this kind per second in a gas can be calculated by means of the kinetic theory as

$$\sqrt{2}\pi\sigma^2\bar{u}n^2e^{-E/RT},$$

where σ is the molecular diameter, $\bar{u}$ the root mean square velocity, and n the number of particles per cubic centimetre. By comparing this expression with

the actual number of molecules reacting, we can calculate the value of the critical increment E. Thus, if k is the velocity coefficient of a bimolecular reaction measured in gram molecules per minute per litre, we have

$$2\sqrt{2}\pi\sigma^2\bar{u}n^2 e^{-E/RT} = k \,.\, C^2 \,.\, \frac{6{\cdot}06 \,.\, 10^{23}}{10^3 \,.\, 60},$$

where C is the concentration of the reacting substance in gram molecules per litre.

An independent means of determining E is provided by a determination of the temperature coefficient, η, of the reaction and calculating according to the Arrhenius equation

$$\eta = e^{-\frac{E}{R}\left(\frac{1}{T} - \frac{1}{T+10}\right)}.$$

So far, the data for three different bimolecular reactions have been available for testing this theory of kinetic activation, namely, the homogeneous bimolecular decompositions of $2N_2O$, $2HI$, and $2Cl_2O$, and the two methods of calculating the critical increment give values in good agreement. In the course of an examination of the data of Bodenstein and his co-workers on the formation and decomposition of the higher oxides of nitrogen (*Zeit. Phys. Chem.*, **100**, 68; 1922), I was struck by the fact that his investigation of the thermal decomposition of nitrogen peroxide provides the means of applying yet a further test to the above theory. Bodenstein and Ramstetter (loc. cit.) found that the thermal change

$$2NO_2 = 2NO + O_2$$

is a homogeneous bimolecular reaction and determined its velocity coefficient at a series of five temperatures between 592° and 656° Abs. From the data given for the velocity coefficient (for example, 204 gram-molecule of $[2NO_2]$ per litre per minute at 627° Abs.) and from the temperature coefficient (1·51 for 10° rise of temperature), the critical increment can be calculated by the two methods outlined above. The only uncertain quantity is the molecular diameter. For this I take the value of $3{\cdot}33 \times 10^{-8}$ cm., by comparison with the identical values found by Rankine for the N_2O and CO_2 molecules. In any case the variation in the value of σ makes very little difference to the value of E, which, for example, is only altered to the extent of 3 per cent by a 100 per cent increase in the molecular diameter.

The results of the calculations for nitrogen peroxide have been added to the table of Hinshelwood given below, and the satisfactory agreement will be seen to provide a further confirmation of the theory of kinetic activation.

Reaction. Thermal Decomposition of	E vel. coeff.	E temp. coeff.	Abs. Temp. of Identical Vel. Coeff. (0·0914 g. mol./litre/sec.).
$2N_2O$	55,000	58,500	956
$2HI$	43,900	44,000	760
$2NO_2$	33,200	32,000	575
$2Cl_2O$	22,000	21,000	384

R. G. W. NORRISH.

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Determination of Noon by Shadow.

CORRECT time is now so widely distributed that devices for the accurate reading of sundials are scarcely more than curiosities; but as a curiosity it may be worth while to put on record a method which I used from 1875 to 1880, by which the meridian passage of the sun was determined to within one second by means of a shadow, without any lens or other optical appliance, thus:

A straight rod, R (Fig. 1), in the plane of the meridian was used as the gnomon, and in the same plane and parallel to R was a straight piece of wire, W, at such a distance from R that the diameter of the latter when viewed from W was half the angular diameter of the sun. When the sun is on the meridian, W casts two shadows of equal intensity corresponding to the equal areas of the sun's disc which are not covered by R. The intensity of these shadows changes rapidly with the sun's motion. If R cuts the sun's limb at the four points A, B, C, D, the areas of the sun's disc left uncovered by R are (if $\angle AOB = \phi_1$ and $\angle COD = \phi_2$) proportional to $\frac{1}{2}\sin\phi_1$ and $\frac{1}{2}\sin\phi_2$, and the ratio of these two quantities gives the relative intensity of the shadow. This is shown in Fig. 2, where the ordinates give the intensity, and the abscissa time in seconds, the unit intensity being that due to illumination by half the sun's disc.

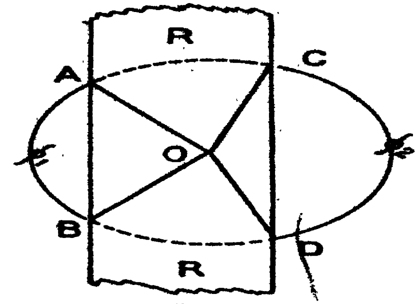

FIG. 1.

It will be seen that when the intensities of the two shadows are identical, the variation in intensity is rather more than 5 per cent per second, a difference which is readily appreciated by the eye, if the screen on which the shadows fall is protected from stray light.

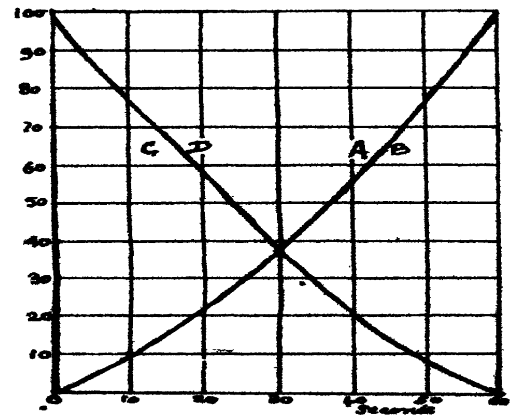

FIG. 2.—Viewed from W, one minute will elapse between the times at which the edge of R is a tangent to the sun's limb, and when the same edge forms a diameter. The curve AB gives the intensity of the shadow of W thrown by that part of the sun exposed between R and AB, CD being the simultaneous intensity of the shadow thrown by the corresponding area between CD and the other edge of R.

A. MALLOCK.

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Exeter.

The Understanding of Relativity.

SIR ARCHDALL REID'S difficulty (NATURE, Nov. 24, p. 808) would probably be eased, if not altogether met, by the "Introduction" of Eddington's "Mathematical Theory of Relativity," more particularly the last paragraph on p. 5.

The difficulty seems to arise from the confusion of two distinct things, an object and its measure, it being mistakenly supposed that the measure of a thing is an absolute property of it and independent of the person who measures it and of his circumstances.

The actual fact is that relativity is not concerned with things in themselves objectively considered, but with their measures, and a measure, whether of an interval of time or of length or anything else, is as much a property of the measurer—or of his instruments, which are merely extensions of himself—as it is of the thing measured, regarded objectively. A measure therefore may be expected to vary with the circumstances of the observer, amongst others, his state of relative rest or motion. It would, in fact, be strange if it did not.

Bearing this distinction in mind, there is nothing incredible in lengths, times, masses, or any other physical quantities measuring up differently according to the state of rest or motion of the system in which they occur, relative to an observer in another system. No experience is contradicted. In fact, the opposite supposition contradicts the known facts of the electromagnetic field, and it is a matter of observation that the mass of an electron changes with its velocity; and if masses, why not times? The question is not whether or not two watches tick together regarded as a purely objective occurrence, but whether one man observes the other man's watch to tick with his own.

Regarding the main question, the understanding of relativity, I would submit that one of the reasons for the comparative failure of so many expositors to make themselves understood has been an injudicious choice of a line of approach to the subject. Of all lines of approach there is none, as I am persuaded, equal to Einstein's own, at least for elementary purposes. It is a matter of much surprise that more writers have not adopted Einstein's definitions of the special and general principles of relativity and developed the subject along the line which these definitions clearly indicate.

Einstein's book suffers from obscurity in many places, but it has the supreme merit of providing a string about which the subject can candy. No doubt the difficulty in crediting the unfamiliar conclusions of relativity must take its share in this failure, but before laying so much blame upon it I respectfully suggest that Einstein's method of approach be tried more widely. I speak from experience, for I have tried this method to the exclusion of all others, and I certainly have no reason to complain of failure, if I may judge from press notices and private correspondence. My first application of this method,—very successful, as attaining its main object, and within its limitations, which were severe,—was public talk some eight or nine years ago, though perhaps the incident has now been forgotten.

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[THE modest remark made by Mr. Bolton in the concluding sentence of his letter refers, we expect, to the fact that in 1921 he was awarded the prize of about £1300 offered by the *Scientific American* for the clearest explanation of relativity for general readers.—ED. NATURE.]

The Thermal Expansion of Mercury.

IN a recently published book on "Heat and Thermodynamics," by Dr. J. K. Roberts, reference is made on pages 202 and 203 to my work on the thermal expension of mercury. Comparison is made in a table between my results obtained by the silica weight thermometer method and those published by Callendar and Moss which were obtained by the Callendar-Regnault absolute method. The author of the book referred to makes the following comment:

> Until the very considerable differences between the values at low temperatures obtained by Callendar and Moss and those obtained using weight thermometers are explained, this table must be taken as representing all that is known about the coefficient of absolute expansion of mercury. The position is obviously unsatisfactory.

It does not appear to be generally known that in a publication (*Trav. et Mém. Int. Bur. des Poids et Mes.*, 1917) there are recorded further observations on the thermal expansion of mercury for the range 0° to 100° C. carried out by Chappuis by the Callendar-Regnault method. These observations agree well with those obtained with the silica weight thermometer, as the following table shows:

COEFFICIENT OF ABSOLUTE EXPANSION OF MERCURY × 10⁶.

Temperature Range. 0° to $t°$.	Harlow, 1914. (By Silica Weight Thermometer.)	Harlow, Revised Values to be Published Shortly.	Chappuis, Weight Thermometer of Verre Dur.	Chappuis, 1917. (By Absolute Method.)
0- 30°	18,168	18,175	18,171	18,189
0- 50°	18,188	18,192	18,183	18,206
0- 75°	18,213	18,216	18,211	18,227
0-100°	18,244	18,248	18,254	18,248

A further paper on this subject has been prepared for publication, in which later and more extensive observations on the thermal expansion of vitreous silica are applied to my observations published in 1914.

F. J. HARLOW.

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Manresa Road, London, S.W.3.

The Magnetic Moments of Hydrogen-like Atoms.

DR. BREIT'S letter in NATURE of Oct. 27 seems to imply that the magnetic moment of a hydrogen-like atom has so far been calculated only for radial quantum number zero. I therefore venture to give the general result, expecting, however, that it has already been calculated by others. The calculation is easily performed by expressing Darwin's functions in terms of Laguerre's polynomials of non-integral rank. It is convenient to write $j = k + 1$ when it is positive and $-k$ when it is negative, and to write $J = \sqrt{(j^2 - \gamma^2)}$, $N = J + p$, $n = \sqrt{(N^2 + \gamma^2)}$, where p is the radial quantum number and $\gamma = 2\pi Ze^2/hc$. We find that the magnetic moment is

$$\frac{j(2l+1)(2Nj+n)}{(2j-1)(2j+1)n} \text{ Bohr magnetons,}$$

l being the equatorial quantum number. This is the expression of spacial quantisation in Dirac's system.

F. B. PIDDUCK.

Corpus Christi College,
Oxford, Nov. 14.

The Recent Eruption of Etna.

By Prof. SALVATORE DI FRANCO, University of Catania.

ETNA has always presented the most varied geodynamic and eruptive phenomena, separated by periods of repose so varied that it is futile to make any attempt to define them with precision. During the nineteenth century there were ten great classical eruptions accompanied by imposing emissions of lava. From 1892 to 1910, Etna did not present any outburst of importance; for the eruption of 1908 in the upper part of the Val del Bove stopped after a few days. Since then, we have had the eruptions of 1911, 1918 (of a few hours' duration), 1923, and the present year.

When Etna is in eruption the lavic magma accumulated in its interior does not as a rule issue from the central crater, but opens a passage in its lateral walls, either because the lava is unable to rise so high as the summit (3313 metres above sea-level) or because it exerts on the flanks of the volcano a pressure so great that it breaks them in places and flows through. Thus, at 16 h. 30 m. (3.30 P.M., G.M.T.) on Nov. 2, 1928, without any warning, an explosion occurred in the highest crater on the north-east side, while the central crater was quite still. At 18h. a new vent opened in the Val del Leone (2700 metres), with emission of lava over about 350 metres; at the same time the subterranean course of the lava was directed to the south of Monte Frumento, so far as the eastern flank of Monte Cubania, where a second vent was opened, the lava from which invaded the valley below and stopped on the plain of the Donne.

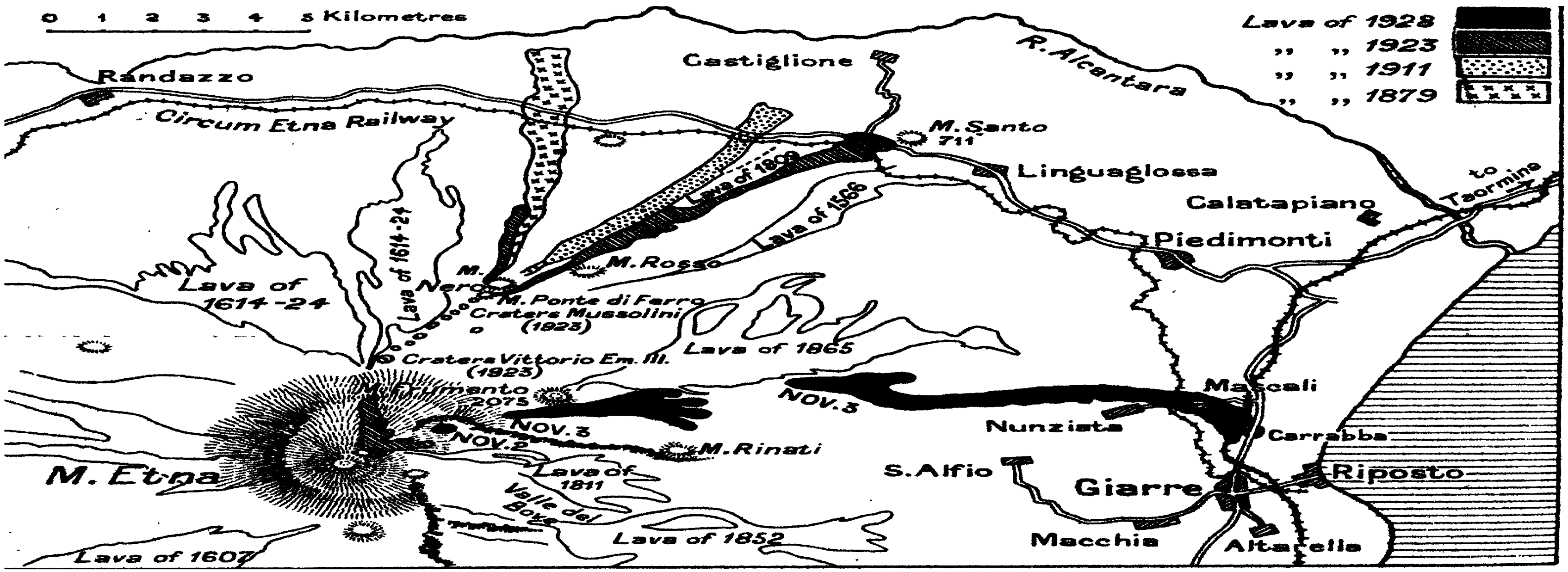

FIG. 1.

Towards the evening of Nov. 3, a more intense lavic effusion prolonged the subterranean course of the lava so far as the region 'La Naca' (1150 metres), where the third vent was opened (Fig. 2), the lava from which emerged and reached nearly to the village of Carabba, about 1500 metres from the sea. Along this subterranean course, small craters occur in the form of buttons and of different magnitudes.

The present eruption of Etna is one of the feeblest recorded in history, but the enormous

damage done is greater than that in other eruptions of longer duration.

The district traversed by the lava is the most fertile on Etna, and what was once the smiling district of Mascali, a flourishing fruit-grove, a luxuriant garden, or a fine vineyard, is now buried beneath an enormous mass of hard and smoking lava. In the piazza of Mascali, after the lava had closed in on the village, the church and belfry still held out; but the lava surrounded it, and, on Nov. 7, the church collapsed, dragging the belfry with it in its ruins (Fig. 4).

Etna in eruption is a truly grand and impressive spectacle that defies description. The rumbling volcano mutters gloomily in its new mouths, and from it issues a fiery stream which at the origin runs like a river of viscous incandescent material; a couple of kilometres farther downwards the movement is shown by the slow sliding of the great masses which cover the interior incandescent pasty mass, whilst in front the movement is manifested by the continuous crumbling of lumps of various sizes, pushed forward by the pressure of the internally fluid lava, and detached from the sides of the mass of lava with a metallic noise, the incandescent mass inside appearing like the interior of a great heated oven.

Photo.] [Pirrone.

FIG. 3.—Cascade of lava near the Fossa Santoro; by night.

The stream then exerts on the lateral moraines formed by the consolidated lava a constant pressure so as to make some point of the moraine give way, determining a rearrangement of the magma, and through this last extension of the stream, districts not invaded at first, and property so far spared, are continually threatened with invasion and consequent destruction.

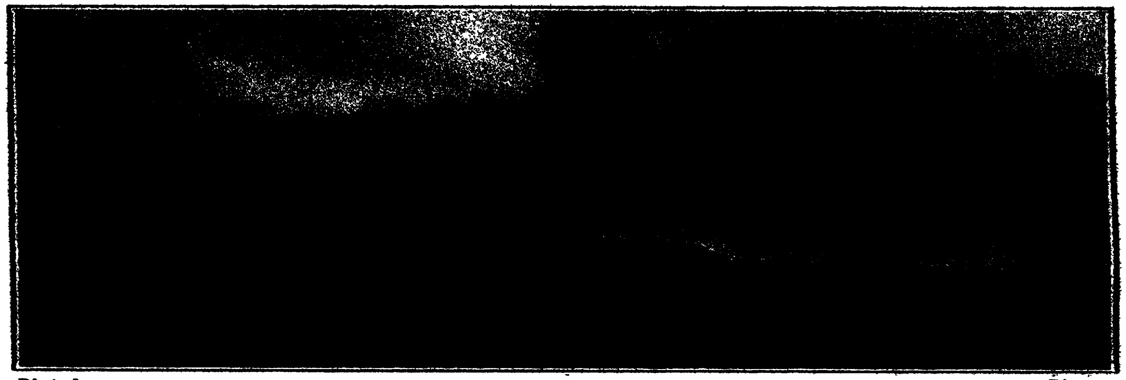

Photo.] Pirrone

FIG. 2.—Principal vent with the liquid incandescent magma on the right; by night.

The temperature of the flowing lava is about 1050°, yet, before issuing, it was higher, because the passage of the gases adds a pressure of many atmospheres to the surrounding pressure, and occasions a loss of internal heat, known as the heat of expansion. A curious phenomenon, which indicates the low temperature of the surface layer of the lava-flow, is the presence of several tree trunks entangled in the crust of the lava that show no sign of the action of heat beyond an incipient charring. Sometimes the stream has dug into the ground so that trees are torn up with all the soil about their roots. Near the lava there is always noticed the smell of hydrochloric acid, and near the eruptive mouths that of sulphur dioxide.

In the recent eruption are noticed blocks of old lava, torn from the deep strata of the ground which form part of the framework of Etna, like the rocks which are observed in the denuded strata and dykes of the Val del Bove. This lava, however, does not represent the true massive compact lava; is of a greyish-black colour, rather heavy, and similar to that of the latest Etnean eruptions. One notices a moderate abundance of enclosures of plagioclase, a little augite and still less olivine, magnetite, and vitreous material.

On Nov. 12 the eruption entered decisively on the decreasing phase, and on the date of writing (Nov. 18) the external manifestations of the

eruption may be said to have come to an end. There are already to be seen fumaroles with beautiful incrustations of sublimated substances, especially of ammonium chloride. On the whole, this eruption of Etna has been of brief duration, briefer than would be expected, seeing the very low position of the mouth from which the lava was emitted. An end so premature was principally due to the lack of fragmentary material. The mouths of the eruptive apparatus were not able to form those great cones which, like monuments, indicate to posterity the hundreds of eccentric eruptions of Etna.

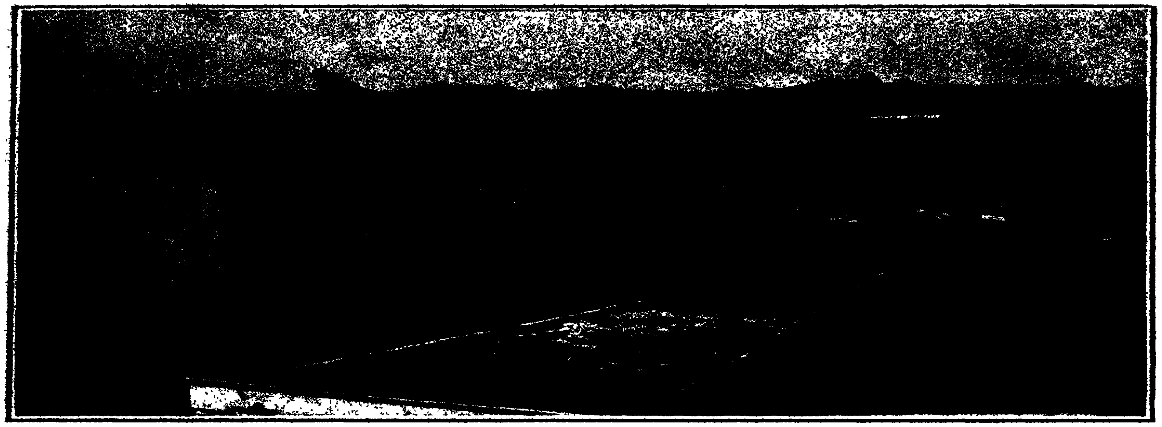

FIG. 4.—The last houses of Mascali burning.

Many threatened villages have been spared, but the district round Mascali remains buried for ever. After the tremendous eruption of 1669, which destroyed many villages and reached as far as Catania and the sea, passing rapidly over 18 km., this is the first instance of a district invaded by lava. At some future time, when the district now covered with lava once again enables plants to flourish and to provide men with means of living, the present eruption will be forgotten or will remain as an historical event, until another will come to revive its memory and pass through the same cycle of events.

A 'Growth Substance' and Phototropic Response in Plants.

THE remarkable development made in recent years in animal physiology in the study of the endocrinal secretions and their relation to growth has naturally encouraged the tendency to find growth-regulating substances in plants. Most such suggestions as yet are notable for their slender experimental basis, so that the more importance attaches to a recent dissertation by Dr. F. W. Went,[1] describing numerous experiments carried out in his father's laboratory at Utrecht, which are regarded by the author as establishing the existence of a growth substance (*Wuchsstoff*) in the organ of one plant, the coleoptile of the oat.

The coleoptile is a remarkable little structure—the first part of the shoot of the oat (or other grass) seedling to emerge from the grain into the air; it is a little hollow cylinder with a conical closed top which is burst through by the first leaf of the plant, when it is left as a collar around the base of the lamina. It has been the basis of innumerable studies in plant physiology, and it is no exaggeration to say that recently scores of papers have come each year from Continental laboratories dealing with this little structure. Indeed, one distinguished German botanist is reported as saying that there is at present a 'coleoptile fashion' in the German laboratories.

The reason for this intensive study is that the coleoptile is the classic object upon which was first demonstrated by Charles Darwin the reception of an external (light) stimulus at one point, the apex of the coleoptile, followed by a growth movement, curvature towards the light, near the base of the object. Thus the response of the plant to light apparently could not be the direct result of the action of light upon a complex growing tissue. Rather we had to deal with an external stimulus received in one region, from which influences then were transmitted which modified the mechanism of growth at work in another region of the plant. Thus the phototropic response of this little organ has profoundly influenced the development of botanical ideas as to growth and its response to light and gravity, etc.

The new outburst of experimental activity upon the coleoptile followed upon some interesting experiments by Boysen-Jensen, in which he showed that if the tip of the coleoptile were cut off and then replaced again upon the stump by the aid of a little gelatin, when the tip was afterwards illuminated laterally, the usual tropic curvature took place in the base of the organ. This immediately seemed to place the growth controlling machinery in the category of substances, in this case diffusible through gelatin, which were moving from the receptive tip towards the responsive base of the coleoptile. The one-sided illumination of the tip then modified either the formation or the subsequent distribution of these substances, or partially destroyed them, so that on their arrival in the basal region, unequal growth now took place.

Since Boysen-Jensen's papers an army of in-

[1] "Wuchsstoff und Wachstum," by F. W. Went. *Rec. des Trav. bot. Néerland.*, 25, 1-116; 1928.

vestigators have entered this field and interpretations are almost as numerous as the workers; it is only intended here, however, to refer to the recent interesting monograph by Dr. Went, which, starting from the phototropic problem, has ended by contributing rather to the more general problem — the nature of the mechanism involved in normal growth.

Dr. Went has developed a most beautiful and careful technique for which reference must be made to the original paper, which is very clearly written and is full of interest. The crucial experiment, repeated in many forms, consists in placing a number of coleoptile tips (grown in darkness and manipulated in red light, to which they are insensitive) upon a thin slice of jelly (gelatin, agar or silica gel). When afterwards a little piece of this jelly is placed asymmetrically upon the cut end of another coleoptile, from which the tip has just been removed, the result is a negative curvature (*i.e.* away from the side receiving the jelly) which is interpreted as due to the growth substances diffusing from the jelly into the base of the coleoptile.

After 170 minutes or so (at 25° C.) this original negative curvature was followed by a positive curvature which soon cancelled the first curvature and is regarded as due to the regeneration of a new 'physiological' tip, which apparently forms first on the side of the cut stump not under the jelly, and from which a new supply of growth substances must be released into the base of the coleoptile. This 'physiological' tip is a very obscure phenomenon. The stump simply heals by slow suberisation and drying at the cut surface; there is no regeneration of active growing cells as when a wound phellogen forms beneath the cut surface.

Dr. Went shows by remarkable experiments that the amount of curvature produced is proportional to the number of tips that are put upon the jelly originally and to the length of time they are left upon it; in fact, that the curvature is determined by the absolute amount of this growth substance thus placed upon the stump of the reacting coleoptile.

Dr. Went is then led to consider how this substance, diffusing from the coleoptile tip, determines its growth. In the first place, the coleoptile exhibits a strictly limited type of growth. No new cells are formed throughout its extension in length, except perhaps in its two vascular bundles, and all increase in length is due to increase in cell size as the result of taking in water. Dr. Went's *Wuchsstoff* must act, then, by modifying this process of extension in cell size, and he suggests that it modifies the extensibility of the wall. Such an effect is a very subsidiary type of growth modification, and it is doubtful if it is desirable to call the substance producing it 'growth substance.'

Curiously enough also, the cells at the tip of the coleoptile, presumably the first to come under the influence of this substance, which Dr. Went shows is only produced at the tip and by no other part of the coleoptile, are the least extended in length in the coleoptile. He is thus led to suggest that there is a second necessary factor governing cell extension, namely, the supply of what he describes as the materials required for wall extension. These are supposed to come from the base of the coleoptile and to be limiting the extension of these apical cells. Presumably, such wall-extending materials would be carbohydrate in nature, and as the cells of the tip, as of the rest of the coleoptile, are originally packed with starch, it is a little difficult to accept this interpretation of the failure of the apical cells to extend in length. There are obviously other alternatives. For successful cell extension the extensible stage in wall development must coincide with the development of high osmotic pressures within the cell. Starch disappearance always begins at the apex of the coleoptile, and possibly the walls in this region are too thick and inextensible to stretch at the time that the rest of the cells of this organ are taking in water and extending.

Dr. Went discusses the mode of transport of the *Wuchsstoff* down the coleoptile. He confirms an earlier observation of Brauner that protoplasmic streaming occurs in the cells, and from his observations of this process concludes that this is responsible for a downward rate of movement which is 200 times too fast to be explained by diffusion. He has some very interesting experiments in which he watches the transfer of the substance from a piece of jelly at the top cut end, down the coleoptile and into a piece of jelly at the lower end. He concludes that some of the substance is missing, 'used up' in the length of coleoptile, though it is not clear why this missing substance should not be looked upon as in transit. He is unable in a similar experiment to get his growth substance carried in this manner *up* the coleoptile from a jelly containing it placed at the lower end. This is surprising, as presumably the streaming machinery should be equally effective in carrying substances in either direction, and, indeed, Dr. Went assumes that it is responsible for carrying the wall-extending materials up to the apical region of the coleoptile from the reserves in the grain.

Dolk's experiments had previously suggested that without the growth substance from the apex of the coleoptile, no extension in length of this organ is possible. Dr. Went is inclined to agree with this, and, indeed, not only in the coleoptile, but also in earlier experiments by Tammes upon shoot defoliation, the effect of such leaf removal upon cell extension in the internode was remarkable. The cells towards the base of the coleoptile are not so long as those farther up this structure. Dr. Went cut out the middle region of the coleoptile and placed the jelly with the growth-promoting substance on the cut stump. He thus obtained a slight elongation (six per cent in three hours) in cells of the stump which previously had ceased to grow, whilst without such jelly no increase in length occurred.

From experiments upon the rate of diffusion, Dr. Went is able to make a rough estimate of the molecular weight of the *Wuchsstoff*. On the assumption that it is non-ionised, he thus arrives at the figure 376. Until now, the substance has defied

chemical characterisation; it is present in such minute quantities in the jelly and probably contaminated by other substances diffusing from the injured cells. It has been impossible to produce similar activity by the use of any pure substance in its place.

A new chapter thus seems to be opened in the study of the correlating influences controlling the process of cell extension in the tissues of the plant. It is safe to predict that the subject will not be left long in this interesting state, but that further work will elucidate the connexion of the apex of the coleoptile with the extension of its base, and at the same time determine the significance of this mysterious *Wuchsstoff* that diffuses from the cut tip when placed on agar.

J. H. P.

The Wright Brothers' and Langley's Aeroplanes.

IN the new wing of the Science Museum, South Kensington, in perhaps the most prominent position, will be found the original Wright aeroplane with a long descriptive notice. This states that it was the first power-driven man-carrying aeroplane to make a free, controlled, and sustained flight. The machine, which was built by Wilbur and Orville Wright, was flown by them on Dec. 17, 1903, at Kittyhawk, North Carolina, and its production was the result of their prolonged experimentation and research, which had been stimulated by the gliding experiments of Otto Lilienthal.

Since the first flights were made the aeroplane has been preserved in the Wright laboratory, but certain parts which had been damaged during their last flight, one extending over 59 seconds and covering a distance of 852 feet, have been replaced, and the machine restored to its original condition.

The fact that this machine, essentially American in ownership and manufacture, should be in the possession of a British museum is rather significant, and is the key to a publication which has just been issued by the Smithsonian Institution, dealing with their relations with the Wright Brothers. The publication, which was issued over the name of C. G. Abbot, Secretary of the Institution, is an attempt to clarify an unfortunate controversy, to correct misunderstandings, and to do justice alike to three great pioneers of human flight—Wilbur and Orville Wright, and Samuel Pierpoint Langley, who, as they themselves said, gave them "a helping hand at a critical time." The details of the controversy, which in parts is rather painful, need not concern us at present, but the difficulty was associated with the exhibition in the United States National Museum in 1918 of a reconstructed variation of a machine which Langley endeavoured to fly in 1903. The label attached to it originally described it as "The original full-sized Langley Flying Machine"; this was later amplified to include a claim that it was the first man-carrying aeroplane in the history of the world capable of sustained free flight; that it was tested over the Potomac River by Langley in 1903, and successfully flown in June 1914.

As a result of the controversy and further investigation into the actual flights carried through by this machine, the label was altered to indicate that in the opinion of "many competent to judge," the machine was the first "heavier than air craft" in the history of the world capable of free flight under its own power, since it had become clear that in the original test no proper flight had emerged. Smarting under a sense of injustice, Mr. Orville Wright presented their machine for exhibition for five years to the South Kensington Museum.

Committees connected with the Smithsonian Institution have investigated the historical accuracy of the statements which have appeared on the labels, and now in this pamphlet the invitation of the Smithsonian Institution to Mr. Wright is renewed, to deposit for perpetual preservation in the United States National Museum the Kittyhawk plane with which he and his brother, it is agreed, were the first in history to make successful sustained human flight in a power-propelled heavier-than-air machine.

As a further display of goodwill, the Institution is willing to let Langley's aeroplane rest on its merits, and has directed that the label on the Langley Aerodrome shall be so modified as to tell nothing but facts, without additions of opinion as to the accomplishments of Langley. The label now reads: "Langley Aerodrome. The original Samuel Pierpoint Langley Flying Machine of 1903. Restored."

No doubt it was because the Wright brothers have always been appreciated in Great Britain for their wonderful pioneer work in this new field of human endeavour that the machine was deposited in one of our Museums. Whether or no it should now be returned to the United States is clearly a matter for Mr. Orville Wright himself to decide. We, at any rate, in Great Britain shall be extremely sorry if it is to leave our shores; but in any case it is to be hoped that the Science Museum authorities will take steps to procure the production of as close a replica as possible.

Obituary.

Prof. T. C. Chamberlin.

A MASTER of research has passed in Thomas Crowder Chamberlin, emeritus professor of geology in the University of Chicago, whose death occurred on Nov. 15, shortly after celebrating his eighty-fifth birthday on Sept. 25. His place is with the greatest thinkers of the past. He leaves few if any equals among his contemporaries. His far-flung research into the processes of the universe is a challenge to younger students to spread wings of imagination toward the unknown, but only with thorough understanding of the course to be flown and constant checking of the navigation.

Chamberlin, the glacialist, geophysicist, and cos-

mogonist, was a geologist in that large meaning which he expressed at the Cleveland meeting of the Geological Society of America a year ago, in calling upon his colleagues to overleap the bounds of a petrified, terrestrial science. Rocks are not dead. They are to be studied as living assemblages of energy, organised according to the laws of physics and chemistry. He bade geologists explore these domains intensively, as their own. He invited them to penetrate the marvellous cosmogonies of the atoms, where in those intimacies of Nature lies hidden the secret of evolution. He unrolled the history of the planet and traced our dynamic descent from our parent, the sun. His concept of geology embraced the solar system and touched the stars. Fully aware that he could not long sustain the effort, he appealed earnestly to his fellows to carry on in all the fields of science of which "astronomy is the foreign department."

Chamberlin will always be known as the author of the planetesimal hypothesis of the birth and growth of the earth. Its fundamental concepts are wholly his. The mutual reactions of the sun and a passing star in giving birth to the planetary system he reasoned from the orderly movements of the planets, as he has more recently argued the erratic origin of comets in the sun's ungoverned, eruptive activity. These concepts are the survivors of a large number of possible hypotheses which he investigated, rigorously applying the method of multiple hypotheses. His endeavour was to find a process that would give rise to swarms of matter endowed with energy in such wise that the dynamic peculiarities of the planetary system might evolve from them. The initial idea of the growth of the planets by a gathering in of planetesimals was forced upon him by the failure of the gaseous and meteoritic assemblages of matter to meet the tests to which he and his collaborator Moulton patiently subjected them. Some thirty odd years ago he compared the work in which he was engaged to that of a miner exploring an old mine to ascertain what of value might have been left in the leads. It was not until he had proved the old leads valueless that he turned to new prospects, which he exploited patiently, persistently, and critically in discriminating search for the true vein of reality.

In collaboration with the colleagues whom he drew about him, Chamberlin was dominant because of the tremendous mental power behind his thinking, but never by assumption of authority. He put forward every idea that his fertile mind conceived. Then he tried each one by natural logic, as his phrase was, and he expected his associates to test his suggestions by every pertinent, crucial fact or by mathematical analysis. He welcomed a justified destructive critique as clearing away an obstruction to advance. He constantly guarded himself and his fellow students against over-confidence in the verity of his assumptions.

Shortly before the appearance of his last work, "The Two Solar Families," which reviews his previous work critically and presents supplementary facts that strongly support the original deductions, Chamberlin wrote: "The most friendly thing that I can urge is that you look critically into my logic and my conclusions. I have, of course, great confidence that in all essentials I am in the line of reality, but it behoves others to discount any self-partiality that may creep into my work." Unfortunately, few are qualified by understanding of geology, geophysics, and celestial dynamics to analyse, much less to criticise, Chamberlin's contributions to the science of the earth and the solar system. His philosophy of geology will not bear its full fruitage until a generation shall have grown up free from the inherited theories that he discarded and open-minded toward the new ideas he inspired.

Chamberlin's intellectual detachment from his own ideas was the more remarkable because he was a man of very strong convictions. He was most conscientiously convinced, however, of the inviolate integrity of truth, and he defended the truth, as facts presented it, from misrepresentation by himself as sternly as from attacks by others. The vigour of his argument, backed by his powerful personality, sometimes conveyed the idea that he was opinionated, but his force of expression simply represented the intensity of his pursuit of actualities. He was infinitely patient with new suggestions, whereas he could be bitingly severe in rejecting the false or meretricious.

In geology, Chamberlin has contributed largely to an understanding of glaciation and Pleistocene climates. He himself would speak with amusement of the apparent inconsequence of his intellectual evolution from a student of glacial cold to an investigator of solar heat. It was a natural evolution, however, for his philosophic mind, which traversed all terrestrial and related phenomena understandingly. His "Manual of Geology," prepared in co-operation with his devoted associate, R. D. Salisbury, is distinguished by its penetrating analysis and correlation of facts, as well as by the consideration of alternative views of unsolved problems.

This is not the place to enumerate his many contributions to geology, to describe his official activities in the U.S. Geological Survey, or his service to the University of Chicago. Neither may we dwell upon his more intimate relations with his fellows. He was a most inspiring teacher provided the student was in earnest. He would discuss his own ideas without reserve with his associates, and he welcomed theirs. He was most conscientious in giving credit to others, and his scorn was unsparing for those who would take credit for borrowed ideas. As mass is energy, so Chamberlin was sincerity; and his sincerity was housed in a great and noble mind.

BAILEY WILLIS.

WE much regret to record the death on Dec. 7 of Dr. J. W. L. Glaisher, F.R.S., senior fellow of Trinity College, Cambridge, at the age of eighty years.

News and Views.

The managing committee of the National Trust estate at Ashridge has recently let the shooting over the property to some local sportsmen. Many naturalists are much concerned at the inevitable interference with the wild life and the consequent destruction of hawks, owls, and other 'vermin.' At a recent meeting, the Herts Natural History Society unanimously passed a resolution deploring the action of the National Trust in letting the shooting rights on the Ashridge estate, recently acquired for the nation by public subscription. The resolution points out that the preservation and shooting of game inevitably entails the destruction, disturbance, and discouragement of various beautiful and interesting forms of wild life; and that the establishment of the Ashridge estate as a national Nature reserve is much more in accord with public feeling, and with æsthetic and scientific interests, than the letting of shooting rights to private persons. Having regard to the facts above stated, the Herts Society urges the National Trust definitely to establish the Ashridge estate as a Nature reserve and wild life sanctuary, which step the continuance of game preserving and shooting on the estate would render impossible. The establishment of Nature reserves is an ecological experiment of the results of which we know at present very little. Animals may need a certain amount of control as well as the vegetation, and aliens such as the grey squirrel have to be prevented from interfering. But at present we imagine that all biologists would agree that the best thing to do is to leave the animals alone and see what happens. Shooting for sport must always be detrimental.

The growing interest in the evidence for so-called spiritualistic phenomena is reflected in the popular symposium which the *Daily News* is publishing. The series of articles appears under the names of a number of different persons in various walks of life who attempt to reply to three questions set them under the terms of reference. The first deals with the point of whether the claims of the spiritualists are proved or disproved, or whether indeed they are likely to be proved or disproved. The second asks for the evidence upon which the conclusions of the writer are based; and the third seeks information concerning the opinion of each contributor as to whether the pursuit of spiritualistic practices tends to be injurious to the minds and bodies of those taking part in them. Mr. Robert Blatchford opened the discussion in a characteristic article, which, however, failed to appreciate altogether the scientific aspect of the question. The symposium is being continued by a number of other writers, including Sir Oliver Lodge, who, in the issue of Dec. 8, wisely refrains from answering directly any of the three questions, contenting himself with an attack upon the mechanistic interpretation of life, and concluding with the statement that the evidence for survival has grown of late years and is still growing. Mr. J. M. Robertson, in the issue of Dec. 10, holds that the history of fifty years fails to afford scientific proof either of (1) 'spiritual' control of inanimate objects, or (2) communications to human beings from deceased persons. The series, although of little importance to scientific men, may be of some interest in so far as it may throw light upon the attraction that spiritualism appears to have for numbers of people, thereby illustrating some curious points in religious psychology and the foundations of belief.

Under the chairmanship of Brigadier-General G. H. Gater, Education Officer to the London County Council, Mr. Ormsby-Gore, Parliamentary Under-Secretary of State for the Colonies, gave a valuable address on "Developments and Opportunities in the Colonial Empire" on Dec. 6, at University College, London, at a public meeting arranged by the Association of Scientific Workers. To the concentration of attention upon the settlement, development, and constitutional issues of the British self-governing Dominions may be attributed the lack of appreciation by the public of the remarkable developments which have taken place during the lifetime of the present generation of the non-self-governing dependencies, said Mr. Ormsby-Gore. After giving a number of striking illustrations of the rapid economic expansion of different colonies, he outlined the tasks of the Colonial Office. The Colonial Office is responsible for the opening up and development of new means of communication in these overseas territories, and the application of science to the problems of agricultural production, public health, and education. The demand for adequately trained personnel is increasing, more especially the demand for those who have received a thorough training in the biological sciences. In particular, the dependencies are now thoroughly alive to the importance of the plant geneticist for the development of new and higher-yielding varieties of all the various tropical crops. But apart from that particular outlet, biologically trained men will find scope for the application of this special knowledge in the administrative and political services. Such knowledge will be an invaluable asset, for it will give them a greater appreciation of the problems awaiting solution and a fuller understanding of the peoples for whose development they are accepting responsibility.

In his introductory remarks, General Gater paid tribute to the energy, enthusiasm, and appreciative understanding which Mr. Ormsby-Gore has brought to bear upon the problem of Empire development. The four personal visits he has paid to the non-self-governing dependencies, first to the West Indies and British Guiana, to East and Central Africa in 1924, to West Africa in 1926, and that to Malaya and Ceylon from which he has only recently returned, indicate his desire to study problems on the spot. The suggestions and recommendations contained in the reports dealing with these visits are alike admirable, and have played a great part in promoting the expansion of the scientific services. As chairman of the Advisory Committee on Native Education in Tropical Africa, Mr. Ormsby-Gore has given abundant evidence also

of his grasp of the essentials in education policy. In thanking Mr. Ormsby-Gore for his address, Sir Thomas Holland endorsed the appeal which he had made for biological teaching in the schools, and for trained biologists for the Colonial Services. Sir Richard Gregory reinforced this appeal, and also referred to the significance of Mr. Ormsby-Gore's appreciative understanding of the rôle which science plays in the development of the world's resources and man's knowledge of his environment, without which there can be no healthy mental and physical growth. Scientific workers are greatly indebted to Mr. Ormsby-Gore for his persistent advocacy in Parliament of the cause of science. Mr. Ormsby-Gore's address will be printed in full in the December issue of the *Scientific Worker*, the official organ of the Association of Scientific Workers. Copies of this journal may be obtained by forwarding threepence in stamps to the General Secretary, Association of Scientific Workers, 25 Victoria Street, London, S.W.1.

AN interesting case of so-called voodoo, or more properly witchcraft, is reported from Pennsylvania by the New York correspondent of the *Times* in the issue of Dec. 5. Three persons have been accused of the murder of a farmer named Ribmeyer in York County. Of the accused, one was a local 'pow-wow' doctor, while of the other two, aged respectively eighteen and fourteen, the family of the elder, named Hess, was convinced that it had been bewitched and consequently had suffered a series of misfortunes. The help of the pow-wow doctor was sought, and he accused Ribmeyer, who lived as a recluse on his farm, and said that the spell would never be broken until they had obtained a lock of his hair. This is a variation of the well-known method of breaking a witch's spell by drawing blood from the witch, but the use of a lock of hair is familiar in principle both in English and American folklore as a method of curing ills such as headache, toothache, or other which may well be the result of a spell. It was stated by the coroner that during the last two years no less than five infants had died in York County as the results of witch-doctoring, but members of the County Medical Society say this figure is much too low. A determined effort is to be made to drive out 'pow-wow' doctors. It is said that voodooism has been practised in York County and rural Pennsylvania since revolutionary times. Presumably 'voodooism' is not to be taken literally, but as a descriptive term for the arts of the witch and dispenser of charms and spells.

DISCUSSING human speech and expression by gesture in a lecture delivered on Dec. 6 at the Royal Institution, Sir Richard Paget stated that children when they invent words for themselves commonly do so by making (unconsciously) a pantomime with their mouths. In archaic Chinese, in ancient Sumerian (as spoken at Ur of the Chaldees), in the Aryan and Semitic languages and even in Polynesia and on the west coast of North America, the same root words occur—made by the same descriptive tongue gesture—as for example the upward movement of the tongue which produces the word 'al,' meaning 'high,' or 'strong' or 'protect' or 'rise.' The human courtship gesture words 'lub' and 'kam' are also found (with small variation) in all these languages. To the objection that the theory of mouth pantomime is fanciful, it may be replied that so is man's unconscious mind, and that we are all born full fledged for flights of fancy but soon moult or are plucked in the course of our education. 85 per cent of the word groups in the first 20 pages of Kailgren's Dictionary show pantomime evidence, while for Aryan roots the proportion is 77 per cent or more, and 86 per cent for groups of Polynesian and North American Indian words collected by Paul Rivet. Both the names and the symbols of the so-called Arabic numerals are formed by mouth or hand pantomime. Hand gestures were less used by the northern races than the southern, because the northerners led harder lives and had less hand leisure. Originally human speech may have been a simple universal language like the universal sign language of deaf mutes; it has since become elaborated and conventionalised. In song the musical language of emotion and the pantomime language of thought are ceremonially wedded. Poetry is a descriptive dance of the tongue and lips performed under the joint direction of the mind and the emotions.

THE problem of the origin of life has been much discussed, and little progress has been made in spite of the researches of the colloid chemist and the experimental physiologist. It has revolved about the relatively simple and yet complex enough microscopic organisms in which plant life and animal life seem to join hands. The problem is, however, pushed one stage further back, speculatively and tentatively, by J. B. S. Haldane in an article on "The Origin of Life" in the *Rationalist Annual* for 1929. He visualises the beginning of living things in a far-back primitive ocean, which, through the uninterrupted action of the ultra-violet rays of the sun acting upon a mixture of water, carbon dioxide, and ammonia in the absence of atmospheric oxygen, had reached the consistency of hot dilute soup (probably rather clear than thick). The discoveries of the bacteriophage and the gene, and that the main difference between the former and a lethal gene, namely, that the latter is only known within a cell and the latter outside, points to the bacteriophage as a gene which has broken loose, and as an ultramicroscopic something, which if not actually alive is on the verge of life. It is a step beyond the enzyme on the road to life. At about the same stage are the viruses which cause such diseases as smallpox and hydrophobia. They can multiply only in living tissue, and pass through filters which stop bacteria.

MR. HALDANE thinks that the primitive organisms were probably ultramicroscopic; further, since they lived in an atmosphere containing little or no oxygen, they must have obtained the energy they needed for growth by some other process than oxidation, namely, by fermentation. The embryos of the most highly organised creatures, chicks and mammals, start life in an anaerobic fashion; so that the phylogenetic test supports the hypothesis. Probably the first living or

half-living things were large molecules synthesised under the influence of the sun's radiation, and only capable of reproduction in the particularly favourable medium in which they originated. But the molecules of organic things possess a persistent type of build, and that suggests a common molecular ancestor, or, in other words, that one, and only one, primitive organism was the fountain-head of all things living. This may have been due to a single happy synthesis, or more likely to the start obtained by the progeny of the first success enabling them to swamp later tentative entrants to the organic world. There is many a 'perhaps' and an 'if' in the story, but it is a speculation which, one of these days, will be put to the experimental test.

THE leading article in NATURE of Nov. 3 on "The Understanding of Relativity" has drawn an inquiry from a correspondent with regard to the idea of gravitational attraction. The questions asked are: "Does the sun exercise an attraction upon the earth? Does the earth exercise an attraction upon a pendulum? Does the attraction of a mountain deflect a plumb-line?" Our correspondent goes on to say that the highest authorities answer these questions in the negative, and their answers are not intelligible to the ordinary student, who is hampered not by want of faith, but by want of understanding. It might be suggested to those who share this difficulty that they ask themselves whether their understanding would be any clearer if the questions were answered in the affirmative. The simple facts that the earth moves towards the sun, that a pendulum tends towards its lowest point, and that a plumb-line leans towards a mountain, are of course data of experience, independent of any theory or explanation, and no one has any difficulty in visualising them. But if one goes further and asks why they happen, is his question really answered more intelligibly if he is told that the sun, or the earth, or the mountain has some mysterious power by which it attracts its distant votary, than if he is told that the latter behaves in the manner natural to it in the circumstances in which it finds itself? Neither answer is of course an 'explanation' in the true sense of the word, and our correspondent might well consider whether his preference for the *deus ex machina* of gravitational force is not a legacy of early years, when anthropomorphic conceptions were more satisfying than abstract descriptions. The contention of the article in question was, of course, not that the whole detailed structure and development of the theory of relativity were simple to understand, any more than are those of the classical electromagnetic theory, for example, but that the *special* difficulty that is supposed to envelop relativity is the result, not of an intrinsically esoteric character, but of instinctive incredulity on the part of the student.

THERE are many obvious advantages in using battery eliminators to get rid of the trouble of charging the accumulators used with ordinary radio receiving sets. When the eliminators are directly connected with the electric mains of the supply company serious risks, however, may arise unless special precautions are taken. The requisite precautions are laid down in the wiring rules of the Institution of Electrical Engineers. In our opinion, the responsibility of instructing the public lies with the retailers of the eliminators. We think that there is a real danger. In the *Electrical Review* for Nov. 30, Mr. Rawll describes some appalling cases of dangerous wiring. In one case he found that a bare wire taken from the supply terminals passed through the kitchen to the receiving set worked off the supply mains in the living room. The full pressure of the supply existed between the water tap in the kitchen and this wire, and in certain circumstances this might easily give a fatal shock to anyone making a circuit between the two. This had been going on for months without those in the house realising the risk they were running. The pressure between one of the supply mains and the gas or water pipes or a damp floor or wall in Great Britain is usually 230 volts. Touching the wire and an earthed conductor with dry fingers the electric shock is usually slight. But between moist hands, or between a moist hand and the feet in damp boots on a damp floor, the shock can be dangerously severe. Experience has shown that the shocks received from alternating current supply mains are more severe than those from direct current supply. When properly installed, radio battery eliminators can be made as safe as the electric wiring used for lighting a house. Apparently many of the amateurs who instal the apparatus are quite ignorant of the risks arising from electric shock.

THE annual congress of the British Institute of Radiology and Röntgen Society, which was held at the Central Hall, Westminster, on Nov. 14–17, proved a pronounced success. The attendances were large and much interest was evinced. The president, Dr. G. W. C. Kaye, Superintendent of Physics at the National Physical Laboratory, referred in his presidential address to the steady growth of the Institute, which, with the affiliated members, now has a membership of 800, and to the increased scientific facilities at the house of the Institute at 32 Welbeck Street. The address included a historical review of the genesis and evolution of the electrical discharge tube in the seventeenth and eighteenth centuries, particular reference being made to the work of von Guericke, Boyle, Newton, Hauksbee, Gray, Nollet, and others. Prof. W. L. Bragg gave the ninth Mackenzie Davidson memorial lecture on the subject of "X-ray Optics," and Mr. Sampson Handley delivered the eleventh Silvanus Thompson memorial lecture on "Radiology from a Surgeon's Standpoint." A day was devoted to a medical discussion on the value of the opaque meal in diagnosis. Among the physical and technical papers read was one by Dr. G. Shearer on industrial applications of X-ray spectroscopy, one by Mr. W. E. Schall on recent developments in X-ray apparatus, and one by Mr. W. V. Mayneord on X-ray dosage and distribution. The British X-ray manufacturers organised an exhibition of apparatus which attracted large numbers and, in its comprehensiveness and progressive nature, was highly to be commended.

A large party of members accepted the kind invitation of the Director of the National Physical Laboratory to visit the Laboratory where, among other things, they were shown in operation the million volt equipment, a Coolidge cathode-ray tube, constant-potential X-ray outfits, together with demonstrations relative to X-ray spectrometry, measurement, and protection.

AMONG the finds which have recently been retrieved from the tomb of Tutankhamen is mentioned an interesting cult object which illustrates the beliefs of the ancient Egyptians in regard to the relation of the god Osiris, the king, and the crops. This was a figure found in a wooden box and heavily wrapped in linen. When the bandages were removed, a hollow figure of wood was found which had been filled with silt from the Nile. In this, grain had been planted and it had then been wrapped as a mummy. The sprouting of the grain would thus make the mummy a symbol of the resurrection of the god Osiris or of Tutankhamen himself.

ON Nov. 30 occurred the centenary of the birth of Gustav Anton Zeuner, the distinguished German professor and director of, first, the Zurich Polytechnic, then of the Freiburg School of Mines, and from 1873 until 1895 of the Dresden Polytechnic. Born in Chemnitz, he passed through the School of Mines in Freiburg, spent some time in Paris, where he became friends with Poncelet and Regnault, and in 1853 assisted to found the journal *Civil ingénieur*. Six years later, the same year that Rankine included in his "Treatise on the Steam Engine" a section on the new science of thermodynamics, Zeuner published his "Grundzüge der mechanischen Wärmetheorie," which was followed by many valuable works on this and other subjects. Zeuner retired from the directorship of the Polytechnic at Dresden in 1895 and died there on Oct. 17, 1907.

THE unity of science was well illustrated in the recent Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers, delivered on Nov. 30, by Prof. W. E. Dalby, who dealt with the possible vibration of a ship's hull under the action of an unbalanced engine. Commencing with the well-known differential equation of vibration of an elastic body when subjected to damping and forced oscillation, Prof. Dalby examined the consequences which ensue when an engine, unbalanced in various ways, is placed at various positions in a ship's hull either coinciding with nodes or between them. Some results of modern practice were described, in which engine vibration trouble in ships had been successfully overcome, and an interesting parallel was drawn between these and the effects of unbalanced railway locomotives on bridges which have been examined recently by a joint committee representing the Department of Scientific and Industrial Research and the railway companies.

THE Council of the Institute of Metals has found it necessary to alter the date of the twenty-first annual general meeting and 'coming-of-age' celebrations of the Institute, from that originally announced (Mar. 6 and 7) to Mar. 13 and 14 next. The programme includes a dinner and dance at the Trocadero on Mar. 13, and a conversazione and exhibition to be held in the Science Museum, South Kensington, on Mar. 14, when objects of special interest in relation to the work of the Institute will be displayed; offers of such objects are invited and should be made to the secretary, Mr. G. Shaw Scott, 36-38 Victoria Street, Westminster, London, S.W.1. The annual May Lecture of the Institute is to be given on May 7 by Sir Oliver Lodge. The annual autumn meeting will be held in Düsseldorf next September, and it is proposed to hold there a general discussion on laboratory methods of metallurgical research.

THE "Statistical Report of the Health of the Navy" for the year 1926 has recently been issued (London: H.M.S.O.). The returns for the total force show a decrease in the incidence of disease as compared with the five years' average and also with relation to 1925. The disease showing much the largest incidence was influenza, of which there were 1769 cases, all of a mild type. Of malaria there were 280 cases, and it is remarked that it is difficult to render a hammock mosquito-proof by means of a mosquito net. Experiments with various types of net-spreaders will, it is hoped, result in obtaining more efficient protection.

A STANDARD time conversion chart, at the low price of ten cents, has been published by Bureau of Standards, Department of Commerce, U.S.A. It consists of a cardboard disc on which the twenty-four hours are marked, twelve in white and twelve in black. The disc revolves on a card on which the meridians east and west of Greenwich are marked. Against certain of the meridians there are place names. More could easily be added by the user. There can obviously be nothing novel in the construction of such a chart, but it is strongly made and boldly printed, and should prove useful in many schools and elsewhere.

AMONG the forthcoming books of Messrs. W. Heinemann (Medical Books), Ltd., are the following: "On Nephritis," Dr. A. C. Alport; "Fruit and Health," Dr. S. M. Belfrage; "The Machine of Life," Dr. Ethel Browning; "Clinical Observations on Infant Feeding and Nutrition," Dr. H. Gladstone; "Common Colds," Dr. Leonard E. Hill and M. Clement; "The Treatment of Varicose Veins by Intravenous Injections," Dr. J. D. P. McLatchie; "The Mechanism of the Larynx," V. E. Negus; and "The Art of Surgery," Dr. H. S. Souttar.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in geography and geology at the Exeter Diocesan College for Schoolmasters—The Principal, Saint Luke's College, Exeter (Dec. 20). A lecturer in chemistry, with special qualifications in physical chemistry, in the Bradford Technical College—The Principal, Technical College, Bradford (Dec. 28). A rural science teacher and assistant agricultural organiser under the Merioneth Education Committee—The Secretary to the Merioneth L.E.A., Education Department, Dolgelley (Dec. 28). A head of the

department of metallurgy, including pure science, of Constantine Technical College, Middlesbrough — The Director of Education, Education Offices, Middlesbrough (Dec. 31). A lecturer in zoology in the Egyptian University, Faculty of Science—The Dean of the Faculty of Science, Egyptian University, Cairo (Jan. 1). A physiologist at the Experimental and Research Station, Cheshunt, for the investigation of virus diseases of plants—The Director, Experimental and Research Station, Cheshunt, Herts (Jan. 31). A full-time teacher of engineering at the Verdin Technical School, Northwich—The Director of Education, Dept. "C," County Education Offices, City Road, Chester. An assistant in the mechanical engineering section of the engineering department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A master to teach workshop practice (particularly metal-work) and either engineering or building trades subjects at the Sheerness Technical Institute and Junior Technical School—The Principal, Technical Institute and Junior Technical School, Sheerness. A man with teaching experience in physics, chemistry, and mechanics, at Cordwainers Technical College—The Principal, Cordwainers Technical College, St. John's Lane, E.C.1.

ERRATUM.—In the letter "Elastic Constants of Single-crystal Aluminium Wire" in NATURE of Oct. 27, p. 650, line 14, for "tenths of a gram" read "tens of grams."

Our Astronomical Column.

USE OF THE 24-HOUR DAY.—About forty years ago an effort was made to assimilate the astronomical and the civil day, making both begin at midnight and using 24-hour reckoning. The effort was a failure, little encouragement being given by astronomers as a whole, and no response being received from the general public. In the last few years the situation has changed; astronomers in general have abandoned the plan of beginning the day at noon, and now follow the civil reckoning in this respect (except that they do not use summer time). This change was suggested by the British Admiralty, and after international discussion was adopted in all the ephemerides from the beginning of 1925. The International Astronomical Union, which met at Cambridge in July 1925, gave further endorsement to the new system, making, however, an exception in the case of the Julian day, which still begins at Greenwich noon.

As regards the use of 24-hour reckoning, there is one department of civil life, namely, the railway timetables, in which its introduction seems desirable. For short journeys there is little difficulty; the use of the symbols A.M. and P.M. at the heads of columns sufficiently meets the difficulty. But in the case of journeys lasting for a large fraction of 24 hours, probably most people find some trouble in interpreting the indications of the tables. The trouble may not be very grave, but it would certainly be diminished by carrying the reckoning of hours up to 24.

The council of the Royal Astronomical Society recently authorised Prof. H. H. Turner to approach the railway companies of Great Britain with this end in view. They replied that they had no objection to the change, but desired an expression of opinion from the general public before making it. Accordingly, a letter appeared in the *Times* of Dec. 8, signed by the Astronomer Royal, by Rev. T. E. R. Phillips (president of the R.A.S.), and Prof. Turner. It gives a brief rehearsal of the above facts, notes that the 24-hour system is general in Continental timetables, and emphasises the fact that the change proposed is strictly limited to railway tables. The failure of forty years ago was largely due to the attempt then made to introduce 24-hour reckoning for all civil purposes: this attempt is now abandoned, so that people may continue to lunch at one and dine at eight, instead of substituting thirteen and twenty. It is hoped that there will be sufficient public response, in one direction or the other, to give the railway companies an indication of the general trend of opinion.

A NAKED-EYE SUNSPOT.—Although not unusually big, a recent group of spots was seen by a number of people through fog or thin cloud prevalent at times during the transit of the spots across the sun's disc. One observer, near Piccadilly, previously unaware of the existence of the spots, saw the two terminal members of the group as separate dots on Dec. 4 when the angle subtended by them was less than 4′. The group was of stream type with the components closely packed, and changes in their shape denoted considerable activity. Spectroscopic observations made at Worthing on Nov. 30 and Dec. 1 provided more precise evidence of this activity. Position and area of the group are as follows:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Maximum Area.
11	Nov. 30–Dec. 11	Dec. 5·6	9° N.	1/800 of hemisphere

A magnetic disturbance was recorded at Greenwich between Dec. 5, 22h. and Dec. 6, 5h.; range in declination, about 40′.

FORBES'S COMET.—From the three positions given in NATURE of Dec. 1, p. 856, Dr. A. C. D. Crommelin has deduced the following elements of this comet:

T	1928 Nov. 7·040 U.T.
ω	198° 32′ 6″
Ω	248 59 4
i	28 39 26
log q	9·87346

These resemble very closely the elements of Comet 1873 VII, discovered independently by Coggia and Winnecke; the latter again resemble those of Comet 1818 I, discovered by Pons. Argelander and Schulhof had already suspected that these two comets were identical, with a period of either 55 years or some sub-multiple of this; since the observed arcs in both years were very short (4 days and 5 days) it was impossible to deduce the period from them. There is good reason to believe that Forbes's comet is the same object, and to hope that it will be observed long enough at the present return to settle the question of the period. The observed intervals are 55·8 and 54·9 years, which do not differ more widely than planetary perturbations give us a right to expect; the recent revolution of Halley's comet was two years shorter than the one before. If the period is 55 years, the aphelion distance would be 28¼ units, not far inside Neptune's orbit, so that it might be looked on as belonging to that family.

The comet is now out of reach in England, but should be followed in the southern hemisphere for two or three months. In the middle of October it was far north of the equator and comparatively near the earth, so that it is rather surprising that it was not discovered then.

Research Items.

STONE AGE INDUSTRIES OF SOUTH AFRICA.—A new classification of the Stone Age industries of South Africa is suggested by Dr. Van Hoepen in Part I. of the *Argeologiese Navorsing* of the National Museum of Bloemfontein. Incidentally, some interesting suggestions are put forward as to the uses of certain of the implements. The classification is typological. The implements of the Stellenbosch, Vaal, and Pniel are equated with Chellean, Acheulean, and Mousterian respectively. The author had previously suggested the substitution of the Pniel culture for the 'Victoria West' culture. In the Koning culture, which is equated with the Aurignacian, a new industry is recognised corresponding with Upper Aurignacian. This is the Poort, so-called from the locality in which it is found, namely, Commissie Poort, Ladybrand district, and characterised by small thumb-nail scrapers and double hollow scrappers, while for the lower Koning culture, corresponding with the lower Aurignacian, is suggested the name Koning industry. Of the remaining cultures the equations are, Stilbay with Solutrean, Mosselbay with Magdalenian, and Wilton with Azilian. In the newly defined Koning industry, the types here described are the trimmer, the disc scraper, and end scraper, flaying knife and curved point. It is pointed out that the term 'scraper' is being applied to implements never used for the purpose of scraping, while they seem admirably adapted for skinning animals, the point being especially well fitted for assistance when the skin holds very tight. The question is raised whether the grey-weathered and red-weathered implements were made by different peoples, or whether worked by the same people at different times, but it is left over for ·uture discussion.

EXPECTATION OF LIFE AND ALCOHOL.—It has frequently been asserted by extreme temperance advoates that even moderate indulgence in alcohol shortens fe, and the experience of insurance companies is that bstainers as a whole are longer-lived than nonbstainers as a class, no distinction being made etween moderate and heavy drinkers. Prof. Rayiond Pearl (*International Clinics*, vol. 3, Series 38, . 27) has attempted to assess the possible influence f *moderate* drinking upon the expectation of life by a ritical statistical analysis of two groups of individuals. 'he first group consisted of 5248 persons whose hisories had been detailed in Prof. Pearl's Institute ecords, the second group of 7500 patients who died n the Johns Hopkins Hospital, whose hospital records vere abstracted. Both groups were divided on the vidence available into abstainers, moderate drinkers, nd heavy drinkers. For both groups the fact merges not only that the moderate drinking of lcoholic beverages did not shorten life, but that the noderate drinkers had a slightly greater expectation of life than the abstainers (0·36 year–1·25 years for nales at different ages, and rather more for females). leavy drinkers, as might be anticipated, had an exectation of life some eight years less than moderate lrinkers at age thirty years, but this difference diminshes with advancing age.

TUBERCULIN TESTING OF CATTLE.—The Medical Research Council has issued a report by Prof. J. B. Buxton and Dr. A. S. MacNalty (*Special Rep. Series*, No. 122. London: H.M.S.O.) on the intradermal tuberulin test in cattle. The tuberculin test by subcutaneous inoculation, which has usually been employed, is ubject to many fallacies and entails the taking of the emperature of the inoculated animal on two or more ccasions. As a result of a questionnaire addressed to a number of veterinary surgeons, the intradermal test is recommended in substitution for the subcutaneous and ophthalmic tests. This consists in injecting into the skin with a special syringe and needle 0·1 c.c. of undiluted 'old tuberculin,' the area of infiltration and thickness of the skin after inoculation being estimated. After forty-eight hours the site of inoculation is again inspected. A positive reaction consists in the appearance of a large diffuse swelling, hot and tender to the touch; if this is the case, the animal is certainly tuberculous. If, however, the swelling consists of a hard pea- or bean-like non-tender infiltration of the derma, the result is inconclusive, and a second similar injection of tuberculin is made into this infiltration. The animal is examined twenty-four hours later, and if negative there is little increase in the swelling; if positive, the swelling becomes large, hot, and tender.

CHINESE FRESH-WATER FISHES.—In the *Bulletin of the American Museum of Natural History*, vol. 58, 1928, Mr. J. T. Nichols gives a provisional check-list of the fresh-water fishes of China ("Article I. Chinese Fresh-Water Fishes in the American Museum of Natural History's Collections." Publications of the Asiatic Expeditions of the American Museum of Natural History. Contribution No. 83), covering material in the American Museum of Natural History up to June 1926. Further collections of considerable importance are expected from the Asiatic expeditions, which have already yielded much that is new. The area investigated is restricted to Old China from the outer limits of Chili Province on the north-east to the outer limits of Yunnan Province on the south-west, and does not include Manchuria, Mongolia, Tonkin, or Tibet. Only strictly fresh-water forms are included in the list, which embraces a very large number of fishes belonging to twenty-four families, of which the Cyprinidæ is the largest with eighty-eight genera and sub-genera and many species. Next in number, but far behind, come the Colobitidæ and the Siluridæ. The list is illustrated by good text figures, including the curiously shaped *Cobitidæ Cobitis*, *Misgurnus*, and *Barbatula*. This should be a valuable help to all those studying Chinese fishes.

LANCASHIRE SEA-FISHERIES INVESTIGATIONS.—The Marine Laboratory and Sea Fish Hatchery at Piel, Barrow-in-Furness, is now closed. This involves the abandonment of several pieces of work. With the present arrangements, however, a certain amount of research in connexion with the local fisheries will still be carried on at the Lancashire Sea Fisheries Laboratory in the University of Liverpool. The present report ("Report for 1927 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel," No. 36, 1928, edited by Prof. James Johnstone) contains a preliminary note on the hydrographical data obtained on the Holyhead-Dublin steamer, and a study of the muscles of the mysid *Praunus flexuosus* by Mr. J. R. Daniel, besides a summary by Dr. Johnstone of the results of trawling experiments made by the Lancashire Fisheries Committee since 1892 in various parts of the district. In this last report it is shown that the abundance of some common species of immature fishes runs in cycles—the plaice being usually abundant about 1895, 1910, and 1920—whilst at the present time they are scarcer than usual, as they were about 1915 and 1905. Mr. Daniel's work on the muscles of *Praunus flexuosus* is valuable. It is on the same lines as his former work on *Crangon vulgaris* (No. 35 of the present publication, 1926), and this

subject shows very similar structure, although there are certain differences. The most important point is the concentration on a longitudinal arrangement of the ventral flexor muscles, and with this is correlated "the ability . . . to spring backwards through the water by means of a sudden and violent contraction of the abdomen, whereby the telson is brought rostralwards." Mr. Daniel has also studied the muscles of *Meganyctiphanes norvegica* but reserves the description, with a detailed comparison of those of *Crangon* and *Praunus*, until a future occasion. The longitudinal muscles of *Praunus* are in striking contrast to the transverse type which predominates in *Meganyctiphanes*, in which the abdomen is only incompletely flexed.

ROOT SYSTEM OF APPLE TREES.—The Annual Report of the East Malling Research Station, Supplement 2, Oct. 1928, contains some remarkable photographs of the root systems of ten-year-old apple trees. The same scion apples are growing upon different stocks, and the differences in the root habit and extent of these two stock root systems are most convincingly demonstrated. Messrs. W. S. Rogers and M. C. Vyvyan describe the methods of root examination employed; they are most laborious. For each tree examined, more than sixty tons of soil had to be finely broken up and moved, a task which occupied four men from seven to ten days. The distribution of the roots was also recorded by methods of grading and weighing. One root stock (Malling IX.) proved to be much more deeply rooting than the other (Malling I.). One point of considerable practical importance is that nearly 50 per cent of the fibre of the root system, the absorbing portion, proved to lie outside a circle five feet distant from the trunk. Thus the common practice of applying manure near to the base of a tree would seem to have little justification. Unfortunately, these laborious investigations can only tell us of the final form of the root system when exposed. At the Dutch experiment station at Wageningen there is an underground glass house above which the trees can be planted so that the growth of the root system can be watched throughout the season. Such growth observations would materially add to the value of such data as are presented in this interesting work.

ROSETTE DISEASE OF GROUNDNUTS.—Groundnuts form the staple crop in the Gambia Colony, and the absence of an alternative crop renders its liability to 'rosette' (virus) disease of considerable importance (*Annual Report*, Dept. Agric. for Gambia Colony, 1927–1928). Investigations show that the insect carrier is probably one or both of two new species of Jassidæ which are being determined. This carrier would appear to be most active between mid-July and mid-August, judging by the incidence of disease, and so far no other food plants than groundnuts have been observed. Infection appears to be carried over from year to year by groundnuts left in the soil, and though other means are probable it seems evident that infection is not carried in the seed. The most susceptible period is the first few weeks after germination, but rainfall at this time reduces the incidence of disease, probably by rendering the insect carrier less active. The effect of the disease is to stunt growth, increase empty shells up to 55 per cent, reduce the good nuts to about 36 per cent, or to render the infected plants barren. Control at present consists in destroying all plants showing signs of disease and all groundnuts that germinate between the growing seasons, and also in sowing the crop so as to avoid drought so far as possible during the first few weeks of growth. Fertilisers appear to have no beneficial effect whatever. Three varieties have been raised which have a high degree of resistance to disease, but so far no fully immune variety has been obtained.

CLASSIFICATION OF COAL.—Scientific investigators have long struggled with the problem of devising some rational system of classification of coals, but the extreme diversity of the properties has made the task difficult. One of the best-known efforts is that of Prof. S. W. Parr, of the University of Illinois, who proposed his scheme twenty years ago. He has republished in the *Bulletin* of the University Engineering Station, No. 180 (pp. 62; 35 cents), his system applied to a large number of analyses of coal from all parts of the world. His method is, briefly, to plot the heating value of the 'unit coal' substance, that is, the pure coal substance free from extraneous or adventitious matter, against the percentage of volatile matter of the 'unit coal.' Classification depends on the area of the chart into which fall the points for individual samples. The results of such classification can be correlated with those obtained by Seyler's method, but confusion results from the different terminology adopted. The *Bulletin* contains a bibliography of the subject and should be of great interest to geologists and chemists interested in the study of coals.

CARBONISATION TESTS.—At the Fuel Research Station, Greenwich, a series of tests has been made on the 'Parkfield Large Gas' coal from the Bristol and Somerset Coalfield (Physical and Chemical Survey of National Coal Resources, Paper No. 12. London: H.M.S.O. 1*s.* 6*d.*). This forms another of the tests made on typical coals from various coalfields in full scale plant. Carbonisation tests were conducted in Glover-West retorts with moderate steaming, when the coal proved a satisfactory fuel, if due allowance was made for its highly swelling character. Satisfactory tests were made with horizontal retorts also. The yields of products were comparable with those previously recorded with a well-known Yorkshire gas coal. In the vertical low temperature iron retorts, the tests again show that modifications were needed to allow for the caking properties. The cokes produced were tested as fuel for a Lancashire boiler, gas producer, and a water gas generator. In all cases trouble ensued owing to the fusible character of the ash. This again shows how important a factor is the ash of coal and how desirable it is to perfect the methods of cleaning coal and applying them when practicable.

FOSSIL ISOPOD CRUSTACEA.—Although probably abundant in past times, isopods are rarely found fossil. An account of all the forms previously known, with descriptions of some new species, is given by V. van Straelen (*Mém. Acad. roy. Belgique*, 9; 1928). The earliest isopod known is from the Middle Trias of Alsace, but its relationship to existing forms is uncertain. A freshwater form occurs in the Rhætic of New South Wales and is referred to the living genus *Phreatoicus*. Marine types belonging to the families Cymothoidæ and Sphæromidæ are found first in the Bathonian. The best-known genus in England is *Archæoniscus*, found in the Purbeck of Wiltshire, which is related to the Sphæromidæ. That family is also represented in the Purbeck by *Cyclosphæroma*. Terrestrial isopods begin in the Upper Eocene. At present palæontology gives no evidence concerning the origin of the Isopoda.

CORRELATION OF THE CAINOZOIC OF VICTORIA, AUSTRALIA.—The richly fossiliferous Cainozoic deposits of Victoria, Australia, have from time to time received the attention of palæontologists in that quarter of the world. It has been found more difficult

there to zone the series from Oligocene to Lower Pliocene than has been the case in Europe and America. This is due mainly to the equability of conditions of sedimentation and climates in the Australian region compared with that of other countries. One forward step towards the correlation of these beds in various localities is made with the conclusion of an examination of the material of the bore cores at Sorrento by Frederick Chapman, Commonwealth Palæontologist, at the National Museum, Melbourne. The work has been in hand since 1912, involving the determination of 10,000 specimens of the larger shells and many thousands of microzoa (Foraminifera and Ostracoda). The description of new species has been the conjoint work of the general author and Miss Irene Crespin, resulting in sixty-one forms new to science. In the earlier part of the work assistance was given by R. A. Keble, of the Geological Survey of Victoria, and now of the National Museum. The spot where the bore was put down is ideal for giving a great thickness of strata, for it is on the downthrow side of the great Cape Schanck fault. It is to be regretted, however, that the boring was not continued farther, for it ended at 1696 feet, still in Cainozoic material, correlated with the Balcombian. Taken side by side with the results given in Chapman's monograph on the borings in the Mallee, there is now every prospect of the general and detailed zoning of the Australian Cainozoics being placed on a surer basis. This will prove of great value in the work now going on under the Commonwealth, of defining stratigraphical horizons with the view of ascertaining geological structure in the regions investigated by scout-boring in oil research. The work, which has been issued in the *Records of the Geological Survey of Victoria* (vol. 5, Part 1), is well illustrated by twelve plates of drawings and photographs by the author and his daughter.

NUMBER OF α-PARTICLES FROM RADIUM.—H. J. Braddick and H. M. Cave, working in the Cavendish Laboratory at Cambridge, have made a new determination of the number (Z) of α-particles emitted from one gram of radium in a second (*Proc. Roy. Soc.*, A, 121, Nov. 1). They have used the indirect method of finding the total charge carried by the α-particles from radium C, the charges collected as the particles were received in shallow copper boxes being measured by the aid of a Compton electrometer. The strength of the sources was found from their γ-ray activity, and in any one experiment the ratio of the α-ray activity of the radium C to its γ-ray activity was constant to within less than one per cent. As the result of sixteen sets of observations, they found that Z has a value of $3{\cdot}68 \times 10^{10}$, their estimated error being plus or minus one per cent. This is in close agreement with what would be expected from recent measurements of the heating effects of radioactive preparations, and it therefore appears that there is no need to invoke the existence of any hitherto unrecognised heat-producing mechanism in these processes.

BANDED STRUCTURES IN METAL CRYSTALS.—In a letter to NATURE last year (vol. 120, p. 259), Dr. C. F. Elam pointed out that banded structures can be observed in copper and aluminium, which have the appearance of twins but do not have a correct relationship for the normal type. She has now carried out further investigations on these, and has been able to show that, contrary to what had been believed previously, aluminium does form twins, of a spinel type (*Proc. Roy. Soc.*, A, 121, Nov. 1). She also suggests that they are much more common than is imagined, but that they are frequently overlooked because they do not exhibit straight boundaries. Another similar structure which she has studied has been shown, on the contrary, not to be of this type; she has described it as 'mechanical twinning.' It appeared when a crystal of aluminium in the form of a round bar was pulled in tension, and deformed non-uniformly, with the production of parallel planes running vertically along the specimen, and it seemed most likely to be formed when two possible planes of slip were inclined equally to the axis of strain. In an appendix to Dr. Elam's paper, Prof. G. I. Taylor has pointed out that her observations of the latter phenomenon are consistent with the laws previously recorded regarding the distortion of aluminium crystals. Dr. Elam's observations were made by the usual crystallographic and X-ray methods.

ARC SPECTRUM OF CÆSIUM.—D. A. Jackson, working in the Clarendon Laboratory at Oxford, has made an investigation of the hyperfine structure of the arc spectrum of cæsium (*Proc. Roy. Soc.*, A, 121, Nov. 1). The difficult problem of obtaining the metallic vapour in a suitable form for excitation was solved by mixing it with helium, and carefully regulating its partial pressure. The containing vessel was exposed to a high frequency oscillator, and the light from it analysed by the well-known method of combining étalons of quartz—by Adam Hilger—with a spectrograph of the Littrow type. The lines of the principal series were found to be close doublets, their separation being about 0·30 per cm. The details of the structure do not appear to be explicable as a result of the interaction of the electrons alone, and to explain this the suggestion is made that it is connected with a spin of the atomic nucleus of one-half quantum, the ratio of the magnetic moment of the latter to its mechanical moment being twice as great as for the electron. The results agree well with those obtained by other workers for the hyperfine structure of some lines due to bismuth, and it has been found possible to devise a selection principle which applies to both elements. The physical meaning of the rule is straightforward—"the greater the change in the relative orientations of the nucleus and electron during the transition, the less probable the transition."

NUCLEAR DISINTEGRATION.—The issue of the *Zeitschrift für Physik* for Nov. 2 contains the reply of Dr. Kirsch and Dr. Pettersson to the criticism of the Viennese experiments upon artificial disintegration that was made recently by W. Bothe and H. Fränz, as the result of their independent researches at Berlin (*Die Naturwissenschaften*, Mar. 23). It is maintained that β-particles do not affect a zinc sulphide screen in any way which would lead to them being mistaken for α-particles or swift protons, and it is further shown by new experiments, that the reputed disintegration protons still appear when possible stray β-particles would have been swept away by a magnetic field. The suggestion of Bothe and Fränz that certain effects were due to a strongly abnormal scattering of α-particles is also apparently disposed of by some other experiments which are described, generally similar to those performed at Berlin, but with a scintillation screen used instead of a Geiger electrical atom counter, and finally the Berlin experiments are themselves criticised on the grounds that the electrical counters used were not properly calibrated, and that occluded hydrogen was not removed from some of the materials employed. Drs. Kirsch and Pettersson take an entirely opposite view to Bothe and Fränz as to how the work of the latter is to be interpreted, and consider that it supports their own conclusions as to which nuclei can be disrupted, rather than those of Sir Ernest Rutherford and Dr. Chadwick. They do, however, concur with Bothe and Fränz in the opinion that electrical methods for registering individual atomic particles are likely to be of great value in this connexion, and it is stated that a report upon the applicability of these is to be published shortly.

Insect Pests in England and Wales.

THE establishment of an advisory entomologist in each of the fourteen provinces of England and Wales as delimited by the Ministry of Agriculture, has provided means for recording the incidence of insect pests that were non-existent at the time the Development Fund Act was passed. Information obtained from such sources, supplemented by that supplied by the Ministry's own officers and other observers, is collated and digested and issued at intervals in the form of reports.[1] The method of presentation aims at chronicling the events of the period under review in such a way as to render them comparable with similar events in the past and future. Observations on the prevalence of a number of the more important insect pests have now been recorded since 1917. Many of the species appear to vary considerably in numbers over long or short periods, conditions being favourable in most years to certain pests and inimical to others. The fundamental causes of these fluctuations are, as yet, not understood, but it is almost certain that climatic factors, with rises or falls in the prevalence of parasites and other biological agencies, play an exceedingly important part. The collection of records of insect abundance or scarcity continued over a period of years, and correlated with meteorological data and such biological factors as can be reasonably accurately evaluated, should be productive of significant information relative to such fluctuations.

The present Report covers the years 1925–27, and during that period certain developments in control measures are noteworthy. The repression of Leather Jackets by the broadcasting of poisoned bran has been tested in many areas in the British Isles, generally with satisfactory results. The Protection of Animals Act, 1911, has been a serious deterrent to the use of this measure, but the passing in 1927 of an amending Act has rendered its application more satisfactory from the legal point of view. The use of naphthalene vapour in glasshouses for the control of red spider attack with special reference to cucumbers and carnations, is an important development from the Lea Valley Research Station. Messrs. Speyer and Owen of the latter institution propose a new method of using sodium cyanide for the fumigation of tomato houses. The mixing of one part by weight of cyanide with three parts of sodium bicarbonate avoids the older method of using sulphuric acid. Paradichlorbenzene, now coming so much to the fore in America, has been found effective for treating dormant bulbs, notably against aphides, while the wider application of this fumigant has evident possibilities. Tar oil winter washes have come much to the fore, but so far they have not given satisfactory control of Apple Capsids and appear to favour an increase of the Red Spider (*Oligonychus ulmi*). The work of Tattersfield and Gimingham at Rothamsted has shown that 3 : 5-dinitro-*o*-cresol has powerful egg-killing properties, but this substance and its salts are yellow dyes, which may prove an objection to their general application.

One of the most difficult problems facing the economic entomologist is the exclusion of pests from other lands. During the period under review, one of the most serious pests that has got accidentally introduced is the Potato Moth (*Phthorimæa operculella*), which occurred chiefly in consignments of new potatoes from the Canaries; fortunately, the insect has not obtained a footing in the British Isles. The frequency of consignments of French cherries infested with the Cherry Fruit Fly (*Rhagoletis cerasi*) has led to the prohibition in 1927 of such importations between June 24 and Sept. 30. Among other importations, the Chrysanthemum Midge (*Diarthronomyia hypogea*) has almost certainly been introduced from the United States, but adequate measures of repression have been taken. The Colorado Potato Beetle, although established in the Bordeaux district of France, happily finds no mention in this Report as occurring in Britain.

Among the various resident pests recorded, a notable feature has been the relatively slight injuries to cereals due to Frit Fly, while Wireworms are not mentioned. In 1925, Leather Jackets were the most serious of cereal pests, but their attacks were less pronounced in the two succeeding years: in 1926, Wheat Midges were especially destructive, 100 per cent of the ears being attacked in one case in Kent. Among root crops, mangolds suffered to a considerable degree from the minute beetle *Atomaria linearis*, which also attacked sugar beet. Attacks of turnips, rape, and swedes by the Swede Midge (*Contarinia nasturtii*) were, on the whole, above normal, while the Mangold Fly (*Pegomyia hyoscyami*) was severe in 1925, its attacks afterwards declining. The Diamond Back Moth seems to be mainly in evidence along coastal regions, and in 1926 destroyed a considerable area of swedes. This species is frequently checked by parasites, but climatic conditions seem to be the most potent restraint; heavy rain, particularly if accompanied by cold weather for two or three days, serves to prevent any notable increase. The disorder known as 'strangle' in mangolds is becoming more generally recognised and is often associated with the presence of Springtails, especially the minute species *Bourletiella hortensis*. At Rothamsted the pest was controlled by dragging tarred sacks over the field, the Springtails being caught on the tar as they leapt from the rows. Peas suffered considerably from the Pea Moth (*Cydia nigricana*) and the Pea Thrips (*Frankliniella robusta*), both species being extremely difficult to control. Vegetables suffered relatively little from aphides, but the Gall Weevil (*Ceutorrhynchus pleurostigma*) attacked *Brassica* crops severely over the greater part of Great Britain during the three years under review.

Among the numerous fruit pests recorded, Capsid bugs merit special mention. The Apple Capsid (*Plesiocoris rugicollis*) is the most serious pest of that fruit in Britain, and is especially prevalent in the Wisbech district. It is, however, assuming greater importance in other fruit areas, and at the present time the only remedy is very thorough nicotine spraying. Another Capsid, *Lygus pabulinus*, has in late years become a serious enemy of bush fruits and quite recently taken to injuring apple shoots; in the past this insect restricted itself mainly to herbaceous plants and weeds, and its spread to bush and top fruits on a large scale is apparently a new development. Among greenhouse pests, an interesting and important development by Speyer at the Lea Valley Station is experiments on the control of the White Fly by intensive breeding of the Chalcid parasite, *Encarsia formosa*.

The Report concludes with a table showing the approximate annual fluctuations in the incidence of some of the major insect pests during the past ten years, with a list of all the pests of chief commercial importance upon which future attention should be concentrated. Mr. J. C. F. Fryer, the Director of the Ministry's Plant Pathology Laboratory, who is responsible for this Report, is to be commended for its practical value and scientific accuracy.

A. D. IMMS.

[1] Ministry of Agriculture and Fisheries. Miscellaneous Publications No. 62: Insect Pests of Crops, 1925–27. (London: Ministry of Agriculture, 1928.) 2s. net.

Gifts for the University of Cambridge.

THE Vice-Chancellor of the University of Cambridge has announced that in answer to the University's application, a formal letter of gift is being prepared by the International Education Board, offering £700,000 to the University on the conditions and for the objects already announced (NATURE, Oct. 20, p. 632). One condition is the raising by the University from other sources of a sum of £229,000, and the Vice-Chancellor is able to announce munificent offers from the Government, the Empire Marketing Board, and the Royal Agricultural Society, amounting to £101,000 in all, of which £85,000 goes towards the sum required. The offers are conditional upon the remaining £144,000 being secured, but they will come as the greatest possible encouragement to the Committee charged with the task of securing to the University the magnificent opportunity presented to it by the munificent offer of the Rockefeller International Education Board.

The Right Hon. Walter Guinness, Minister of Agriculture and Fisheries, in communicating the Government's offer, writes as follows:

"The Board's generous benefaction recognises the position of the University as a great international institution of education and research; His Majesty's Government recognise equally that the University is a great national and a great imperial institution. Again, the particular purposes to which the benefaction is to be applied—primarily the advancement of agriculture and of the fundamental sciences on which agriculture depends—are such as must command the unhesitating support of His Majesty's Government in relation both to this country and to the interest of the Empire overseas. . . . They believe that the highest national as well as imperial interests demand that the scheme agreed between the Universities and the International Education Board should be fully carried into effect. The Government offer a sum of £50,000 in respect of expenditure directly attributable to the School of Agriculture in the strictest sense."

The Right Hon. L. S. Amery, Principal Secretary of State for Dominion Affairs and for the Colonies, in making an offer of £50,000 on behalf of the Empire Marketing Board, writes as follows:

"In a review which has now extended over more than two years, the Board have come to appreciate the great contribution which the University of Cambridge is already making to scientific agricultural research in the Empire at home and overseas. This offer, they are satisfied, holds out the promise of a development of high significance to every Empire country."

This substantial Government support, taken as an indication of the official attitude to research, will be most gratifying to scientific workers generally.

The Council of the Royal Agricultural Society has also made a generous offer of £1000. Cambridge men may be looked upon loyally to support the endeavours being made to raise the balance remaining, £144,000.

Structure of the Great Barrier Reef.[1]

THE results being accumulated by the Great Barrier Reef Committee of Australia, the activities of which are directed by Prof. H. C. Richards, are highly creditable, but the task of closely investigating about ¼ million square miles of land, reef, and water is herculean. Investigations have to be governed by finance and the number of researchers available. The result here is a lack of system, which, however, has had its parallel in the investigations of the coasts of Great Britain and elsewhere.

Past earth movements may be studied in the topography of land surfaces, but we are glad to see that in addition a boring was put down near Cairns, a coral island within the barrier reef being selected. The same difficulties were met with as at Funafuti, insufficiently consolidated and irregular material making drilling difficult. The boring log showed coral material to 113 ft., ooze and mud to 213 ft., coral again to 241 ft., followed by ooze to 427 ft., and then glauconitic material with quartz sand to 600 ft. It is suggested that this is to be interpreted as indicating subsidence of 600 ft., but we cannot accept this until we know what were the foraminifera obtained and have certain evidence that they exist only under quite shallow water conditions. The glauconite must have formed at the time of deposition, and the depth at which it occurred appears to us about the usual depth at which it commences to be formed. We trust that this core will be closely compared with the bottom deposits obtained by Dr. Yonge's expedition, which is working in the same region. Either this deposit was formed before the outer barrier grew up or is the filling up of the lagoon behind the same, as subsidence or other change of level took place, and we find difficulty in accepting either interpretation. A comparison with the deposits near Great Sandy Island at the south end of the Great Barrier Reef might perhaps be interesting.

Mr. Stanley's study of the physiography of the Bowen district, 20°-21° S., is an important contribution to the interpretation of the formation of the Great Barrier Reef. Here there are lines of high islands running almost parallel to the mainland with the shelf-like surface of the Great Barrier Reef outside, 33-50 fm. deep. The chief of these islands is Whitsunday, which gives its name to a Passage on its landward side, a trench varying up to 50 fm. deep. The trend lines of the islands, of which seventeen are described, are much interrupted and the channels between the lines may be rather trough-like. The basal rocks are granites and palæozoic volcanics, figuring equally, and this is true of the coastal ranges. Many of the islands are deeply dissected and there are pronounced embayments, the cliffing being relatively small, this suggesting a long period of subaerial erosion followed by submergence. Along some of the trend lines recent elevation is well marked, and, as it may be absent on their western sides, tilting is suggested. In various bays coral reefs are growing, but these would appear to be in process of formation, and not contemporaneous with, or of the same structure as, the barrier formations to seaward.

It is difficult to follow the author without an adequate chart of depths, in addition to his series of plans and drawings. He gives evidence to show that the relative resistance to weathering and to subsurface marine action cannot have acted as producing the systematic arrangement of the island lines. Hence warping is postulated, parallel to the present coast line, accompanied by the formation of huge parallel fault blocks, cross faulting limiting their extension and causing breaks. This took place subsequent to almost mature subaerial dissection, and the barrier flat to the east is hence a drowned land and its even surface due to marine cutting down and filling in of inequalities. Daly's Glacial Control Theory, a former lowering of sea-level by 30-50 fm., is called in to explain its

[1] "Reports of the Great Barrier Reef Committee," vol. 2. Pp. xvi+114+12 plates. (Brisbane: A. J. Cumming, 1928.) 10s.

submergence, but this is of relatively little importance, if the geological evidence from the coast and islands is to be interpreted as postulating crustal movements extending to the steep fall of the outer reef to ocean depths, a matter also considered in a separate paper by Dr. Bryan on the Queensland Continental Shelf.

Excellent as his work is, we could wish that Mr. Stanley had examined the subsurface topography. We want to know the depths off his cliffs, accurate sections, and we would like the angles of slopes of the lands on either side of some of his deep embayments, with his calculations as to the alterations in level that these require. In any case, the area may well prove to be one in which earth movements are in progress, and the author's account of the lands, together with the Admiralty's re-survey of the seas, should enable these to be deduced in subsequent decades.

Captain Edgell, who was in charge of the re-survey, contributes some general remarks on the coral formations. He suggests that individual reefs of the outer barrier may be fitted together to form atolls with comparatively deep water in the midst of each series, the lagoons. His comparison with Ari and other Maldivan atolls appears apt, but he does not make it clear whether his group of five reefs is to be regarded as an atoll in formation or in decay. The narrow gut, two cables or so across, and about 10 miles long by 30 fm. deep, with almost surface reefs on either side, is an extraordinary feature, being apparently kept open by strong tidal streams.

The topography of the Townsville littoral and other areas shows, according to Mr. Jardine's observations, prolonged denudation, together with coastal drowning, these followed by a slight emergence of 10-20 ft., that has materially added to the coastal plains. This is supposed to be due to a comparatively recent retreat of the sea-level, as seen also in the beaches of the volcanic Bramble and Darnley islands. Bramble Reef also has a small sand cay of foraminiferal tests, coral and shell fragments, much of it consolidated into surface rock by the droppings of birds, as on so many guano islands.

J. S. G.

University and Educational Intelligence.

GLASGOW.—Prof. Andrew Hunter, of the chair of chemical physiology in the University of Toronto, has been appointed Gardiner professor of physiological chemistry in the University. Prof. Hunter has contributed much to our knowledge of the metabolic products of protein, and of dietary defects and deficiency diseases. He will come into residence in Glasgow next year. It will be recalled that his colleague in the University of Toronto, Prof. J. R. R. MacLeod, has recently been appointed to the chair of physiology at Aberdeen.

Sir Frederick C. Gardiner and his brother, William G. Gardiner, have established a fund, amounting to some £20,000, for the endowment of a chair of music in the University. The professor will hold simultaneously the post of principal of the recently formed Scottish National Academy of Music in Glasgow.

LONDON.—The following doctorates have been conferred: D.Sc. in anthropology on Prof. F. G. Parsons, University professor of anatomy, for a thesis entitled "The Englishman of the Future"; D.Sc. in biochemistry on Mr. William Robson, King's College, for a thesis entitled "The Metabolism of Tryptophane, The Mechanism of the Mode of Formation of Kynurenic Acid from Tryptophane in the Animal Organism"; D.Sc. in physiology on Mrs. Norah Edkins (Bedford College), for a thesis entitled "A Study of Absorption in the Stomach and small Intestine"; D.Sc. in psychology on Mr. J. W. Cox (University College), for a thesis entitled "Mechanical Aptitude: its Existence, Nature, and Measurement."

A SPECIAL course of lectures by Prof. H. Dingle on the technical applications of the spectroscope is to be given in the Technical Optics Department of the Imperial College of Science and Technology next January. The institution of the course follows a suggestion by Sir Herbert Jackson, and is an attempt to revive interest in the spectroscope among scientific workers in general, particularly chemists and biologists, so that its uses may be applied to problems in their own domains.

THERE will be an election to not more than three Beit Fellowships for scientific research in July next. These fellowships are tenable for two years at the Imperial College of Science and Technology. Candidates must be less than twenty-five years of age, of European descent by both parents, and of university degree standing. Forms of application, to be returned by April 16, and all information may be obtained, by letter only, addressed to the Rector, Imperial College, South Kensington, London, S.W.

AT the annual meeting of the Court of Governors of the London School of Hygiene and Tropical Medicine held on Nov. 30, the Board of Management of the School presented its fourth Annual Report. Substantial progress has now been made towards the completion of the organisation of the School, of the building, and of its equipment. The work of the old School of Tropical Medicine which was taken over in 1924 continues to make most satisfactory progress, and the Director reports that there is an increase of no less than 17 per cent in the proportion of students sitting for the Diploma in Tropical Medicine and Hygiene who were successful. Advanced courses in bacteriology have been established in temporary quarters in Gordon Square, and all of the five students who sat for the new University Diploma were successful in obtaining it. Special courses in epidemiology and vital statistics have also been established. The professors of public health, of bio-chemistry, and of chemistry as applied to hygiene have been appointed, and will enter upon their duties next year. It is hoped that the handsome building in Portland stone which is being completed in Bloomsbury to the design of Mr. Morley Horder and Mr. Verner O. Rees will be ready for the formal opening next summer.

THE committee of award of the Commonwealth Fund Fellowships announces that it is now prepared to receive applications for the fellowships to be awarded in 1929. After four years' working, the scheme has been so successful that the directors of the Fund in New York have increased the number of ordinary fellowships from twenty to thirty. The ordinary fellowships are tenable at an approved American university for two years. They are open to persons of British descent domiciled in England, Scotland, Wales, or Ireland who are graduates of recognised universities therein and are unmarried and not more than thirty years of age. Women as well as men may apply. Provision amounting to approximately £600 per annum will be made for the total expenditure involved during the tenure of a fellowship. Applications must be forwarded through the authorities of the university or college of which the candidate is, or was, a member. The committee also announces this year five fellowships for graduates of Dominion universities and three fellowships for persons of British descent holding appointments under the British Government, the Government of India, or the Government of a British Dominion, Colony, Protectorate, or Mandated Territory. All information can be obtained from the secretary to the Committee of Award at 50 Russell Square, London, W.C.1.

Calendar of Customs and Festivals.

December 13.

PICROUS DAY.—The second Thursday before Christmas Day was observed by the miners in the Blackmore district of Cornwall as a feast celebrating the discovery or first smelting of tin by a man named Picrous. It was the occasion of a merry-making, to which the owner of the tin stream made a contribution of one shilling per man.

December 17.

SOW DAY, at one time observed in Scotland and so called from the custom of every family killing a sow on this day—one of several customs round about Christmas suggesting the sacrificial meal, of which the pig was the victim, sacrificed to the sun or one of the deities of the Nordic pantheon.

SATURNALIA.—This, the most widely known and frequently mentioned feast of Roman antiquity, took place on Dec. 17–23. It commemorated the reign of Saturn over Italy, who, as god of sowing and of husbandry, settled mankind on the land, taught them husbandry, brought them to live in peace, and made the earth bring forth abundantly. The festival was supposed to reproduce the conditions of his reign—the Golden Age. Feasts and revelry prevailed, all regulations were abrogated, and schools were closed. Most remarkable of all its features and most frequent subject of comment among ancient writers was the licence allowed the slave population. All distinctions between free and servile were temporarily abolished. Not only was the slave free to behave with the utmost freedom, and even with insolence, towards his master and to sit at his table, but also the master actually served the slave at table and waited until he was fed before satisfying his own needs. In each household the slaves held the high offices of State, consul, prætor, and the like, in a mock republic. Among the freemen a mock king was elected by lot, who issued playful or ridiculous orders to his subjects.

Sir James Frazer has suggested that in the mock king and his derivatives, the lords of misrule, abbots of unreason, and similar offices, we have a survival of the primitive ruler who was sacrificed periodically for the promotion of fertility as a representative of the vegetation spirit, and that winter festivals, of which the Saturnalia was one, reproduced in modified form the spirit and ritual of these occasions. He bases this view of the Saturnalia on a life of St. Dasius, who suffered martyrdom at Durostorum on Nov. 24, A.D. 303. According to this narrative, it was the custom of the Roman soldiers on the Danube under Maximian to elect one of their number to act as King Saturn. After thirty days' complete licence in every form of indulgence, he cut his throat on the altar of Saturn at the time of the Saturnalia. The parallel with primitive custom elsewhere, for example, Mexico, is exact (see Frazer's "Golden Bough," Abridged Edition, pp. 583-4). Both theological and antiquarian writers in England in the seventeenth and eighteenth century commented on the similarity between the Saturnalia and the celebrations at Christmas, while some also derived the ancient Feast of Yule of the north from the Roman festival. The comparison was supported by the recognised licence sometimes granted persons of low life, such as that in the official proclamation which permitted card players, prostitutes, and others to frequent the city of York during the period of twelve days' holiday.

December 21.

ST. THOMAS.—A method of divination was practised by girls with 'St. Thomas Onion.' An onion was peeled and wrapped in a clean handkerchief and placed under the head. After appropriate verses had been repeated, the inquirer slept lying on her back.

St. Thomas's Day is especially associated with the practice of 'thomasing' or 'gooding'—a custom which was not necessarily confined to this day, as it was usually kept up until Christmas, and in some localities began in some form, though not necessarily under this name, so early as Martinmas. Women called from house to house collecting gifts in kind, flour, corn, or wheat, later often commuted for a money gift. When the gifts were in kind, the material thus collected was saved up until Christmas time, when it was made into a cake. This was marked with one or more crosses, and it was ceremonially cut on Christmas Eve, and everyone entering the house during the Christmas celebrations was required to partake. Sometimes the cake was marked with crosses with a knife at the time of cutting.

In Warwickshire the custom was known as 'going a-ciorning,' and in Herefordshire as 'mumping.' It was usual for a sprig of holly or mistletoe to be given in return to the donors. At Biddenham, in Bedfordshire, an annual payment of £5 from an estate formerly belonging to the family of Boteler was made to the overseers of the poor for the purchase of a bull to be killed and the flesh distributed among the poor on this day. At Wokingham, in Berkshire, bull-baiting used to take place on St. Thomas's Day, the flesh here also being distributed among the poor. This custom continued down to 1821. The bull was purchased out of the proceeds of a bequest of 1661. For many years after the abolition of the bull-baiting, attempts were made by the people to revive it. The bulls continued to be purchased for the distribution of the meat, the offal being sold to buy boots for women and children, and the tongues—for by this time the money was sufficient to buy two bulls—being reserved for clerk and aldermen.

Similar endowments existed in other parts of Great Britain, though some have been transferred to Christmas Eve or Christmas Day. At Farnsfield the interest on £50 was divided among poor old men and women who could repeat the Lord's Prayer, the Creed, and the Commandments before the vicar or his representative, and at Arundel and Nevern, in Pembrokeshire, there were doles of a similar character; while at Tainton, in Oxfordshire, a quarter of barley was provided annually to be made into small loaves called 'cobbs,' which at one time were distributed in the church to the poor children of Burford. However pious or philanthropic the aims of the founders of these charitable gifts, in common with other Christmas doles, they are derived ultimately from the communal sacrificial meal.

A custom is said once to have existed in York, which was instituted to commemorate the betrayal of the city by two friars when it was besieged by William the Conqueror. On St. Thomas's Day a friar of St. Peter's should ride through the city with his face to the tail of his horse, holding in one hand a rope, in the other a shoulder of mutton, a cake hanging at his back and another on his breast, and his face painted like a Jew. He was to be preceded by the officers of the city proclaiming that on this day the city was betrayed, and followed by the youth of the city shouting 'youl, youl.' After the dissolution of the monasteries, the custom was kept up by artisans.

In the Isle of Man the people used to go to the mountains on St. Thomas's Day to catch ducks and sheep for Christmas, and in the evening light a fire on every 'fingan' or cliff. At the time of cutting turves, a large one was always laid aside for 'Fingan's Eve' (*see* St. Finnan, Dec. 12).

Societies and Academies.

LONDON.

Royal Society, Dec. 6.—A. E. Boycott, C. Diver, S. Hardy, and F. M. Turner: The inheritance of sinistrality in *Limnæa peregra*. This snail is normally dextral; a sinistral variety, in which the spiral twist of body and shell is completely reversed, is very rare. Sinistrality behaves as a Mendelian recessive, but the appearance of any change of twist imposed by crossing is delayed one generation. Albinism is also a simple Mendelian recessive but inherited directly. The delayed inheritance of sinistrality may be due to the twist of animal and shell being determined before the spermatozoon has time to be fully effective.—**R. H. Burne**: A system of 'fine' vessels associated with the lymphatics in the cod (*Gadus morrhua*). These vessels follow the chief arteries (except those to viscera). They have minute connexions with efferent branchial vessels, and peripherally they break up in skin and mucous membrane of the mouth and pharynx, there communicating with the capillary plexus of lymphatics. It is suggested that the lymphatics evolved from a blood vascular system containing both arteries and veins; the venous component became definitive lymphatics, whereas the arterial component vanished. In Teleosts the arterial component persists as the 'fine' vessels.—**E. Hindle**: Further observations on Chinese kala-azar.—**Eric Ponder**: Hæmolysis by brilliant green and serum.—**A. V. Hill, Grace Eggleton, and P. Eggleton**: The coefficient of the diffusion of lactic acid through muscle.—**C. H. Best, K. Furusawa, and J. H. Ridout**: The respiratory quotient of the excess metabolism of exercise.—**A. V. Hill and W. Hartree**: The energy liberated by an isolated muscle during the performance of work. A new point of view is presented in connexion with the thermodynamics of muscle. Extra energy is given out, when work is performed, only if work be done during continuance of stimulus. The muscle behaves like a gas suddenly brought in contact with a reservoir of heat and allowed to expand. If such contact be maintained during expansion, extra energy, equal to work, will be taken from reservoir and work will be greater. In muscle some 'intensity' factor is increased by the stimulus; if the stimulus be continued, 'intensity' is maintained at full value, more work can be done and extra energy set free.—**A. V. Hill**: The diffusion of oxygen and lactic acid through tissues. The diffusion of dissolved substances through tissues is considered for certain cases—a plane sheet, a semi-infinite solid, a cylinder—which are mathematically soluble.—**D. Keilin**: Cytochrome and respiratory enzymes. Cells of aerobic organisms contain four hæmatin compounds, an unbound hæmatin and the three hæmatins (a', b', and c') of cytochrome, and a thermolabile indophenol oxidase. The latter takes an important part in cellular respiration. Cytochrome (especially a' and c') is oxidised by it and is reduced by dehydrases. Cytochrome acts therefore as a carrier between two activating mechanisms of cells: dehydrases and oxidases. Autoxidisable component b' of cytochrome and free protohæmatin can act as carriers between the dehydrase system and molecular oxygen, and also as direct catalysts.—**F. R. Miller and N. B. Laughton**: Myograms yielded by Faradic stimulation of the cerebellar nuclei.—**D. Burk**: The free energy of glycogen-lactic acid breakdown in muscle.—**F. C. Smith**: The ultra-violet absorption spectra of certain aromatic amino-acids and of the serum proteins. *Amino-acids*.—In tyrosine, two new bands have been found, at wave-lengths 2240 A. and 1940 A. *Serum Proteins*.—Samples of exceptional purity were employed. True absorption occurred. Though proteins are precipitated by ultra-violet radiation, exposure for photography causes no measurable change. Contrary to the work of Judd Lewis, horse and human serum-albumin spectra are found to be identical within experimental limits. The ratio of extinction coefficients at head and foot of curve may be taken as index of purity of protein.—**A. S. Parkes**: The functions of the corpus luteum. (Pts. 1-3).

Geological Society, Nov. 7.—Sydney George Clift and Arthur Elijah Trueman: The sequence of non-marine lamellibranchs in the Coal Measures of Nottinghamshire and Derbyshire. The succession of the genera *Carbonicola*, *Anthracomya*, and *Naiadites* is discussed. In general features, the sequence is similar to that of the South Wales coalfield. The lowest horizons are rich in large specimens of *Carbonicola*. Above them, but below the horizon of the Barnsley Seam, occur species of *Anthracomya* and *Carbonicola* characteristic of the zone of *Anthracomya modiolaris*. The zone of *Carbonicola similis* is not separately recognised in the area. The sequence of faunas, and particularly the range of *Carbonicola* and *Naiadites* within the '*Similis-Pulchra*' zone, appear to be of value in determining horizons above the Barnsley Seam.

Physical Society, Nov. 23.—G. Temple: The physical interpretation of wave mechanics. The principles are illustrated by discussions of the propagation of free electric waves in uniform electromagnetic fields, of bound electric waves in the hydrogen atom, relativistic wave mechanics (prior to the work of Dirac and Darwin) and the Compton effect.—**Allan Monkhouse**: The effect of superimposed magnetic fields on dielectric losses and electric breakdown strength. Both are seriously affected by superimposed magnetic fields. A theoretical explanation is suggested by a paper read by Prof. A. Smouroff before the International Mathematical Conference at Bologna in September last.—**Albert Campbell**: A new A.C. potentiometer of Larsen type.—**E. F. Herroun and E. Wilson**: Ferromagnetic ferric oxide. The authors confirm the observation by Messrs. Sosman and Posnjak that lepidocrocite, but not göthite, yields on dehydration a strongly ferromagnetic ferric oxide. As all the specimens of lepidocrocite examined contained 3 or 4 per cent of manganese oxide, this substance may be an essential constituent of this crystalline form of the hydrate. The temperature at which the ferromagnetic oxide is permanently transformed into the common paramagnetic kind is largely dependent upon its mode of preparation. Although copper ferrite has a higher maximum permeability than ordinary precipitated magnetic oxide of iron, it falls far below that of the purer forms of native magnetite. The different susceptibilities of ferric oxide resulting from the oxidation of natural magnetites are attributed to impurities, particularly magnesia, which forms a magnetic ferrite.

Linnean Society, Nov. 29.—T. A. Sprague and E. Nelmes: The herbal of Leonhard Fuchs. Identifications of the 511 plants figured, with a general account of the herbal. The classification is mainly (1) pharmaceutical and economic, but sometimes (2) philological: thus (1) *Campanula Rapunculus* L. is classed with the swede and the beet, because it has an edible root, and is widely separated in consequence from *C. Trachelium* L., which was used as a remedy for ulcers; and (2) *Momordica Balsamina* L. and *Impatiens Balsamina* L. are placed in the same chapter (genus) because the former was called *Balsamina* and the latter *Balsaminum*.

PARIS.

Academy of Sciences, Oct. 29.—**Ch. Fabry**: The rôle of the atmospheres in the occultations of stars having an apparent sensible diameter. Excepting the passage of one of the satellites of Jupiter behind the planet, phenomena of this class are rare. An occultation of the satellites of Jupiter by Mars would be much easier to observe, but such an occultation is unfortunately very rare.—**R. Bourgeois**: The work carried out by the geographical service in 1926 and 1927. An outline of the work included in the last published report.—**Pierre Weiss** and **G. Föex**: The atomic moments. Theories relating to atomic moments attempt to connect the moments deduced from magnetic measurements with the principles of atomic mechanics and the electronic models of the atom, either for comparing the moments obtained in other ways, especially from spectrum analysis, or to study the effects of atomic linking, polar or complex, on the atomic moment. Adopting the value 1126·5 as the number for the experimental electron, the atomic moments of various ions and elements are recalculated.—**Charles Nicolle** and **Charles Anderson**: A new recurrent spirochæte, pathogenic for the guinea-pig, *Sp. sogdianum*, transmitted by *Ornithodorus papillipes*. This organism has its origin in Russian Turkestan. White rats, white mice, and the ape (*Macacus*) can be infected, but not so seriously as the guinea-pig. As regards its specificity, a first attack confers immunity, but *Sp. hispanicum*, *Sp. duttoni*, *Sp. crociduræ*, *Sp. normandi* do not confer immunity against *Sp. sogdianum*.—**Piazzolla-Beloch**: Surfaces of the third order possessing curves with connected branches.—**Bertrand Gambier**: Sub-groups of the group of homographies. Application to the study of skew curves.—**Walter Saxer**: The structure of normal families of meromorph functions.—**R. Mazet**: The commencement of the flow through a thin-walled weir.—**L. Escande**: Flow on overflow weirs.—**Jean Ulmo**: Polarisation in the theory of light quanta.—**Adolpho T. Williams**: The ultimate lines of mercury and aluminium.—**M. Prettre** and **P. Laffitte**: The ignition temperature of hydrogen and air. The figures given are about 100° C. lower than those of other workers, with the exception of Dixon.—**A. Travers** and **Malaprade**: A new fluoboric acid. Boric and hydrofluoric acids react instantaneously, giving a fluoboric acid which differs from HBF_4, as its salts are easily decomposed by alkalies. HBF_4 is formed slowly, a state of equilibrium between the two fluoboric acids being finally reached.—**Raymond Delaby** and **Pierre Dubois**: The formation of allyl alcohol. The preparation of the formins of glycerol.—**L. Maume** and **J. Dulac**: Correlation between positive antagonism and absorption by the plant. Studies on the amounts of lime absorbed by wheat in the presence of sodium salts.—**Charles Pérez**: The evolutive cycle of *Rhizocephalus* of the genus *Chlorogaster*.—**J. Legendre**: The psychology of *Culex pipiens*. The final act of reproduction in females of *C. pipiens* is not due to a physiological automatism. The emission of the eggs is delayed if the necessary water is not present.

Nov. 5.—**Ch. Fabry**: Remarks on the diffusion of light and of Hertzian waves by free electrons.—**H. Douvillé**: The Pic de Rébenacq and its eruptive rocks.—**J. Costantin**: A fungus station recently started in the forest of Fontainebleau. An account of experiments on the culture of *Pleurotus Eryngii* in the forest of Fontainebleau. The possibility of the culture of this edible fungus on the large scale has been proved.—**H. Vincent**: The toxic index of the strains of *Bacillus coli*. New remarks on the basis of anticolibacillus serotherapy. The toxic power of coli bacilli is independent of the strain and of the biological peculiarities (secretion of indol, fermentation of lactose, action on neutral red). Both true coli and para coli bacilli have the common property of fabricating a neurotropic toxin.—**Charles Nicolle**, **Charles Anderson**, and **Jacques Colas-Belcour**: Experimental study of the spirochæte of the gondi (*Ctenodactylus gondi*).—**Charles Nicolle**, **Charles Anderson**, and **Jacques Colas-Belcour**: First attempts at the adaptation of a spirochæte of fowls to various species of *Ornithodorus*.—**A. Th. Masloff**: A class of *W* congruences.—**G. C. Moisil**: Functional varieties.—**Mandelbrojt**: Some new theorems on the singularities of Dirichlet's series.—**K. Abramowicz**: Transformations of automorph functions.—**Georges Valiron**: The values of a meromorph function in the neighbourhood of a singularity.—**R. Swyngedauw**: The relations which connect the various kinds of slip to be distinguished in belt transmission.—**Paul Ditisheim**: Correction for the effect of the magnetic field on the rate of watches.—**Carl Störmer**: An echo of short electromagnetic waves arriving several seconds after the emitted signal: its explanation according to the theory of the aurora borealis. In the autumn of 1927, J. Hals noted an echo of the radio-signals emitted from Eindhoven, arriving about three seconds after the original signal. In an attempt to repeat this observation, after a long series of negative results, a series of echoes was observed on Oct. 11 last. The delay in the echo varied from three to fifteen seconds, averaging eight seconds. These echoes have their origin in space beyond the moon's orbit. A theory is developed to account for the phenomenon based on the supposition of the existence of swarms of electrons under the influence of the earth's magnetic field: this gives a delay in hearing the echo of the order of those observed (see NATURE, Nov. 3, p. 688).—**H. Deslandres**: Remarks on the preceding communication.—**Mario Bossolasco**: The ellipticity of the terrestrial equator.—**H. Roussilhe**: The correct restitution of a figure in three dimensions. Application to aerial photographs.—**Th. De Donder**: Relativist generalisation of the new theory of Einstein.—**A. Féry**: The variation of the specific resistance of thin layers of platinum as a function of the thickness and of the temperature. The specific resistance of thin films of platinum deposited by cathode dispersion is a function of the thickness, and the experimental results can be expressed by two equations: $2 \log (\rho/\rho_0) = 11 \cdot 48 - 0 \cdot 0135a$ and $2 \log (\rho/\rho_0) = 3 \cdot 245$, where ρ is the specific resistance given by experiment, ρ_0 the specific resistance of ordinary platinum, and a the thickness in mm $\times 10^{-6}$. For a thickness greater than 287 mm. $\times 10^{-6}$, the specific resistance becomes independent of the thickness, but still has a resistance 40 times that of ordinary platinum. If the film is heated to 340° C., its resistance falls to that of ordinary platinum.—**G. Foëx**: The crystallisation of mesomorphic substances in the magnetic field. The preparation of a solid with oriented molecules.—**L. Décombe**: Electrified spherical pellicles and the privileged orbits of Bohr-Sommerfeld.—**P. Daure**: Study of the secondary radiations observed in the molecular diffusion of light by fluids (Raman effect).—**M. Ponte** and **Y. Rocard**: The Raman effect in the domain of the X-rays.—**Paul Gaubert**: The structure of the crystals of heulandite.—**Henri Mémery**: The summer of 1928 and the solar variations. Two facts are emphasised, that the year 1928 is the maximum of the solar period commencing in 1923, and that an important recrudescence of sunspots and faculæ occurred between June and October 1928. With rare exceptions, such as the summers of 1900 and 1911, corresponding to a small number of sunspots, the cause of nearly all abnormal temperature variations on the earth can be traced to variations in

solar phenomena.—Léon Aufrère: The orientation of sand dunes and the direction of the wind.—C. Dauzère: A storm observed at the Pic du Midi and the formation of hail.—J. Chaze: The localisation and disappearance of alkaloids in the epidermis of the tobacco leaf. The theory which regards alkaloids in plants as excretory substances is now generally admitted. New experiments are described of morphological and microchemical order which support this view.—Marc Simonet: The number of chromosomes in the common iris (*Iris germanica*).—Marc André: Researches on the post-larval development of *Leptus autumnalis*.—Serge Youriévitch: A new method of recording ocular movements. The ocular cinegraph.—Georges Bourguignon and Henri Laugier: The variations in chronaxy in fatigue by sustained voluntary contraction in man.—R. Leriche and R. Fontaine: Experimental indication of peripheral vaso-motive regulation independent of the general circulatory regulation.—Philippe Fabre: The production of a rectangular wave for researches in chronaxy.—Mme. M. L. Leroux-Legueux: Some points concerning reproduction in amphipod Crustacea: the temporary ovisacs, their formation and their function.—Mlle. D. Van Stolk, E. Dureuil, and Heudebert: The conditions of formation and destruction of vitamin-D during the irradiation of ergosterol. A continuation of the work of Heilbron, Kamm, and Morton on the action of ultra-violet light on ergosterol. The destruction of the vitamin in the course of the reaction is regarded by the authors as due to oxidation, and this can be prevented, or at least retarded, by working in an atmosphere of nitrogen.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 22).—D. A. Grave: Evaluation of the true influence of the electric hyper-atmosphere on terrestrial magnetism.—B. P. Titov and A. A. Levin: A method of determination of the variations in the volume of the arm due to the pulsations of heart. An apparatus for observing and recording the variations is described.—L. S. Berg: New data on the problem of the origin of the fauna of Lake Baikal. The endemic fauna of Baikal consists of two elements: (1) forms which developed in the lake itself during its long geological history; (2) relics of a fresh-water (and brackish-water) fauna which inhabited northern Asia (and North America) and parts of central Africa during the late Tertiary. A large number of forms which have been for a long time considered peculiar to Lake Baikal are now known from other places.—A. I. Argiropulo: The systematic position of the Turkestan rat (*Rattus turkestanicus* Satunin). The Turkestan rat is distinct from *Rattus rattus* (L.), but conspecific with the Indian *R. vicerex* (Bonh.), though representing another race. A diagnosis of *R. turkestanicus turkestanicus* Sat. and the characters separating it from *R. turkestanicus vicerex* (Bonh.) are given.—K. K. Flerov: The seasonal variations in the hairs of *Capreolus*. Detailed descriptions of colour changes in the hairs during different seasons are given. The winter coloration is caused by the gradual loss of the lustre and by the brown and fawn shades of colour being replaced by grey, owing to the rubbing off of some hairs.—J. P. Kravetz: Magnetic anomalies. The paper by D. A. Grave (*Comptes rendus*, No. 16-17; 1928) on the subject is discussed, and the arguments of that author stated to be founded on a misunderstanding.

VIENNA.

Academy of Sciences, July 12.—R. Weiss and J. L. Katz: Triphenylmethanes with linked benzol nuclei. Preparation of an imino-phenylene-acredine-derivative, and the dependence of the colour of the compound upon the nature of the atomic groups forming the rings.—O. Brunner: The amyrines. Dehydrogenating experiments with amyrin.—J. Pollack and E. Gebauer-Fülnegg: Coupling reactions.—E. Gebauer-Fülnegg and J. S. Reese: The directing influence of carbethyloxyl groups in phenols.—E. Gebauer-Fülnegg and E. Neumann: Note on sulphur-containing derivatives of *p*-dichlor-benzol.—E. Gebauer-Fülnegg, W. H. Stevens, and E. Krug: Sulphuric acid esters of the carbohydrates.—E. Riess, F. Berndt, and G. Hitschmann: Phenol and cresol sulpho-chlorides.—E. Riess and F. Pilpel: Determination of the constitution of cresol disulpho-chloride.—E. Späth and F. Breusch: The electrolytic reduction of cyclic acid imides to hydrated cyclic bases.—E. Späth and E. Kruta: The synthesis of berberine-like bases from compounds of the type of tetra-hydro-papaverine.—F. Sigmund and F. Haas: The reduction of the secondary hydroxyl group in ricinoleic acid.—A. Kieslinger: Geology and petrography of the Kor Alps. (9) The structure of the Kor Alps and their relations to neighbouring regions.—F. Bothe: The influence of the substratum and some other factors on the luminescence and growth of *Mycelium x* and *Agaricus melleus*. Alkali chlorides and sulphates promote luminescence, alkali nitrate in 2 per cent solution still more, but ammonium salts weaken. Zinc increases both growth and luminescence. An addition of dead fungus material of the same or other species, also in varying order fructose, glycerine, cane-sugar, promotes the effects. The optimum temperature is about 16°.—E. Chwalla: The stability of centrically and excentrically compressed rods of construction steel. The invalidity of the Euler formula has led to further inquiries about slender rods.—K. Höfler: Visible alterations in living protoplasm evoked by salts. Onion scales were placed in various innocuous neutral salts in isotonic or plasmolysing solution. With favourable cell material the resulting appearance depends on the special salt. The appearances due to alkali salts are different from those due to cane sugar or to the alkaline earths.—W. Leopold: The genus *Cardamine* with special reference to the question of hybrids in the section Dentaria.—F. Weiss-Tessbach: Communications of the Radium Institute. (224) Micro-calorimetric measurement of the absorption of γ-rays from radium-*C*. An ether calorimeter was used.—G. Kirsch and H. Pettersson: Communications of the Radium Institute. (225) The question of the yield in atomic disintegration experiments.—F. Urbach: Communications of the Radium Institute. (225*a*) The theory of the form of the bands in absorption of light and emission from solid bodies. By one argument the oscillating atom would give a spectral line with minimum intensity at the mean frequency; by another argument a superposition of many such abnormal frequency curves would give a normal frequency distribution.—A. Basch: The error-tensors and the law of transfer of error in the elementary operations of vector algebra.—F. Emich: The observation of streaks in chemical work. By observing the streaks with a microscope when a drop of one liquid enters another it is possible to tell which liquid is optically denser.—F. Hölzl: Organic acids and bases in non-aqueous solutions. (4) Phenols and amines. Electric conductivity measurements made it possible to trace the combining proportions of ammonia and the amines with the phenols.—O. Ampferer and W. Hammer: Results of the geological exploring expedition in West Servia. (3) Tectonics and morphology of the Zlatibor massiv.—R. Wagner: Symmetry relations of the panicles of *Paulownia Rehderiana*.

Official Publications Received.

BRITISH.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1163 (Ae. 327): On the Convection of Heat from the Surface of an Aerofoil in a Wind Current. By L. W. Bryant, E. Ower, A. S. Halliday and V. M. Falkner. (T. 2614.) Pp. 24+36 plates. 1s. 3d. net. No. 1166 (Ae. 330): The Force acting on a Body placed in a Curved and Converging Stream of Liquid. By Prof. G. I. Taylor. (T. 2604.) Pp. 10+1 plate. 9d. net. (London: H.M. Stationery Office.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 30, Part 1, Session 1927–28. Pp. viii+65+8. (Edinburgh.) 7s. 6d.

The University of Leeds: Department of Leather Industries. Report of the Advisory Committee on the Work of the Department during the Sessions 1926–27 and 1927–28. Pp. 10. (Leeds.)

University of Cambridge. Department of Agriculture: Farm Economics Branch. Report No. 11: An Economic and Financial Analysis of Five Eastern Counties Farms in 1927–28. By R. McG. Carslaw and W. H. Kirkpatrick. Pp. 13+6 tables. (Cambridge: W. Heffer and Sons, Ltd.) 1s. net.

An Investigation of the Milk Yield of Dairy Cows: being a Statistical Analysis of the Data of the Scottish Milk Records Association for the Years 1908, 1909, 1911, 1912, 1920 and 1923. By Dr. J. F. Tocher. (From *Biometrika*, Vol. 20B, Part 2, September 1928.) Pp. 105-244. (London: Biometric Laboratory, University College.)

Livingstone College. Annual Report and Statement of Accounts for the Year 1927–28. Pp. 24. (London: Leyton, E.10.)

The Quarterly Journal of the Geological Society. Vol. 84, Part 3, No. 335, October 31st. Pp. 381-584+15 plates. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

University of Bristol: Department of Agriculture and Horticulture. Bulletin No. 3: The Effect of different Balanced Rations on the Yield and Composition of Milk from Dairy Cows. By A. W. Ling, C. A. MacEachern and C. Comely. Pp. 19. (Bristol.)

Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122B/T). Pp. 21. (London: Ministry of Health.)

Memoirs of the Geological Survey of India. Vol. 50, Part 2: Descriptions of Mollusca from the Post-Eocene Tertiary Formation of North-Western India. Gastropoda (in part) and Lamellibranchiata. By the late E. Vredenburg. Pp. xiii+351-506+xxi+plates 14-33. 6.10 rupees; 10s. 9d. Vol. 51, Part 2: The Geology of Poonch State (Kashmir) and adjacent portions of the Punjab. By D. N. Wadia. Pp. 185-370+xxxiv+plates 2-11. 7.6 rupees; 11s. 9d. (Calcutta: Government of India Central Publication Branch.)

The Rhodes Scholarships: Statement for the Academic Year 1927–1928. Pp. 12. (London: The Rhodes Trust.)

The Research Association of British Paint, Colour and Varnish Manufacturers. Second Annual Report, submitted to the Statutory General Meeting held at Teddington, 17th October 1928. Pp. 24+2 plates. (London.)

FOREIGN.

Smithsonian Miscellaneous Collections. Vol. 73, No. 5: Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 98 to 104. (Publication 2978.) Pp. 28. Vol. 81, No. 5: The Relations between the Smithsonian Institution and the Wright Brothers. By Charles G. Abbot. (Publication 2977.) Pp. 27. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 87: Notes on the Buffalo-Head Dance of the Thunder Gens of the Fox Indians. By Truman Michelson Pp. v+94. (Washington, D.C.: Government Printing Office.) 65 cents.

Papers of the Mount Wilson Observatory. Vol. 3: Revision of Rowland's Preliminary Table of Solar Spectrum Wave-Lengths, with an Extension to the Present Limit of the Infra-Red. (Publication No. 396.) Pp. xxi+238. (Washington, D.C.: Carnegie Institution.) 2.75 dollars.

Cathodo-Luminescence and the Luminescence of Incandescent Solids. By E. L. Nichols, H. L. Howes and D. T. Wilber. (Publication No. 384.) Pp. vii+350. (Washington, D.C.: Carnegie Institution.) 4.00 dollars.

Archaeological Investigations in Kamchatka. By Waldemar Jochelson. (Publication No. 388.) Pp. viii+88+19 plates. (Washington, D.C.: Carnegie Institution.) 2.75 dollars.

San Luis Catalogue of 15333 Stars for the Epoch 1910. Prepared at the Dudley Observatory, Albany, New York, under the direction of Lewis Boss (1906–12) and Benjamin Boss (1912–), assisted by Richard H. Tucker, Arthur J. Roy and William B. Varnum. (Publication No. 386.) Pp. lvii+307. (Washington, D.C.: Carnegie Institution.) 8.25 dollars.

The Mosquitoes of America. By Dr. Harrison G. Dyar. (Publication No. 387.) Pp. v+616 (123 plates). (Washington, D.C.: Carnegie Institution.) 5.00 dollars.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 179: Forest Insurance and its Application in Michigan. By Paul A. Herbert. Pp. 34. Special Bulletin No. 182: Strawberry Growing in Michigan. By R. E. Loree. Pp. 29. Technical Bulletin No. 93: Observations on the Pathology of Bacterium Abortus Infections. By E. T. Hallman, L. B. Sholl and A. L. Delez. Pp. 19+17 plates. Technical Bulletin No. 95: Studies in Flax Retting. By Antoinette Trevithick, B. B. Robinson and R. M. Snyder. Pp. 49. (East Lansing, Mich.)

The University of Chicago: Publications of the Yerkes Observatory. Vol. 4, Part 7: Astrometric and Photometric Statistics of certain of Hagen's Fields Photographed with the 24-inch Reflector. By Harriet Mc[illegible]ams Parsons. Pp. v+92+2 plates. (Chicago: University of Ch[illegible] Press; London: Cambridge University Press.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1569: Earthworms as Pests and otherwise. By W. R. Walton. Pp. ii+14. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 74, No. 8: Five new Parasitic Flies reared from Beetles in China. By J. M. Aldrich. No. 2753.) Pp. 7. (Washington, D.C.: Government Printing Office.)

Proceedings of the Imperial Academy. Vol. 4, No. 8, October. Pp. xix-xxx+445-512. (Tokyo.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 6: The Intersecting Twin Earthquake of Tango Hinterland in 1927. By Dr. Bunjirô Kotô. Pp. v+265-329+plates 53-65. 2.40 yen. Vol. 2, Part 7: Pliocene Shells from Hyuga, by Matajiro Yokoyama; Neogene Shells from the Oil-Field of Higashiyama, Echigo, by Matajiro Yokoyama. Pp. 331-362+plates 66-69. 1.00 yen. (Tokyo: Maruzen Co., Ltd.)

CATALOGUES.

Catalogue de livres anciens et modernes, rares ou curieux, relatifs à l'Orient. (No. 8.) Pp. 64. (Paris: Libr. Adrien-Maisonneuve.)

Rheostats and Resistances. Pp. 20. (London: Isenthal and Co., Ltd.)

Rare and Interesting Books; 17th, 18th and 19th Centuries. (No. 22.) Pp. 82. (Newcastle-on-Tyne: William H. Robinson.)

India: its Arts and Architecture, Natural History, Religions, Sports, etc. (Catalogue 512.) Pp. 71. (London: Francis Edwards, Ltd.)

Choice Books, mostly in Contemporary or Fine Modern Bindings. (Catalogue 513.) Pp. 57+10 plates. (London: Francis Edwards, Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 14.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science), at 2.30.—Prof. P. Groom: The Antiseptic Preservation of Wood.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—Lord Olivier: The Improvement of Negro Agriculture.

ROYAL ASTRONOMICAL SOCIETY, at 5.—G. Shajn and O. Struve: On the Rotation of the Stars.—Prof. E. A. Milne: Ionisation in Stellar Atmospheres: Part II. Absolute Magnitude Effects.—H. Zanstra: The Excitation of Line and Band Spectra in Comets by Sunlight.—M. Minnaert: The Distribution of Energy near the Limb of the Sun.—C. Easton: A Photographic Chart of the Northern Milky Way.—J. Evershed: High Dispersion Prism Spectra.

BIOCHEMICAL SOCIETY (in Laboratories of J. Lyons and Co., Ltd., Hammersmith Road), at 5.—Prof. J. C. Drummond and L. C. Baker: Further Chemical Studies of the Vitamin A Fraction of Liver Oils.—B. Russell-Wells and Dr. P. Haas: The Hydrolysis of Carragheen Mucilage.—C. R. Harington: The Resolution of d, l-thyroxine.—M. W. Goldblatt: The Action of Insulin in Young Rabbits.—E. Clenshaw and I. Smedley Maclean: The Nature of the Unsaponifiable Matter from the Lipoids of Spinach and Cabbage Leaves.—L. H. Lampitt and P. Bilham: The Effect of Some Constituents of Milk on its Hydrogen Ion Concentration.—D. H. F. Clayson: The Diastatic Digestion of Raw Wheat Starch.—L. H. Lampitt and J. B. Bushill: Some Observations on the Determination of Surface Tension by the Ring Method, with Special Reference to Egg Albumin.—E. B. Hughes: Some Observations on the Production of Liesegang Rings.

IMPERIAL COLLEGE CHEMICAL SOCIETY, at 5.—H. L. Riley and others: Informal Discussion on The Problem of Molecular Structure.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Clinical Meeting) (at Royal Westminster Ophthalmic Hospital), at 5.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Dr. Ezer Griffiths: A Survey of Heat Conduction Problems (Lecture).

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.—G. C. Robson: Remarks on the Evolution and Classification of Octopoda.—L. R. Cox: Notes on the post-Miocene Ostreidæ and Pectinidæ of the Red Sea Region with Remarks on the Ecological Significance of their Distribution.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—E. G. Herbert: Cutting Tools Research Committee: Report on Machinability.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—T. H. Lockett: The Applications of Electricity in the Printing Industry.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section), at 7.—Prof. F. M. Rowe and Dr. C. P. Bean: The Effect of After-treatments on the Degree of Aggregation and Fastness Properties of Insoluble Azo Colours on the Fibre.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—E. J. H. South: Locomotive Boiler Washing Plant.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Prof. W. A. Scott: Commercial Paper.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at College of Technology, Manchester), at 7.—Ll. B. Atkinson: How Electricity does Things (Faraday Lecture).

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—Prof. F. M. Rowe and Dr. C. P. Bean: The Effect of After Treatments on the Degree of Aggregation and Fastness Properties of Insoluble Azo Colours on the Fibre.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Municipal College, Burnley), at 7.15.—S. Stanworth: Comparison of English and French Moulding.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—N. E. Box: The Dismantling, Transportation, and Erection of Heavy Machinery.

KEIGHLEY ASSOCIATION OF ENGINEERS (at Temperance Institute, Keighley), at 7.30.—J. H. Lee: Conveying.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Department of Applied Science, Sheffield University), at 7.30.—L. Wright: Chromium Plating.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—R. A. Bellwood: Present Day Methods of Oil Extraction.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. C. A. Robinson: The Treatment of Pelvic Inflammation by Diathermy.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group).—Swindin: The Air and Gas Lift as a C[illegible]

SATURDAY, DECEMBER 15.

INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—J. F. C. Friend: Roof Control on Longwall Faces.—*Papers open for discussion*:—Extracts and Recommendations from the Report of the Water Dangers Committee, T. G. Davies; Notes on the Conversion of Main Pumping from Steam to Electricity, with Special Reference to the Plant Installed at Messrs. The Stella Coal Company's Clara Vale Pit, L. H. Forster.—Exhibition and Description by M. Jordan of A Patent Drag for Pit Tubs.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. Bayes: The Gulf between Painter and Public (II.).

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at Royal Anthropological Institute), at 3.—Miss P. Holman: Habit and Repetition.

PHYSIOLOGICAL SOCIETY (in Department of Physiology, London (R.F.H.) School of Medicine for Women), at 3.30.—W. Leyshon: Cathode Ray Oscillograph Records of Discharge Current in Neon Tube Circuit.—M. Lowenfeld and S. T. Widdows: Factors Influencing the Secretion of Fat in Human Milk.—H. Dryerre: The Action of Atropine on the Elasmobranch Heart; Evidence Suggesting the Presence of Cardio-acceleration Fibres in the Vagus (Preliminary Communication).—H. A. Dunlop: The Nature of the Depressor Action of Adrenaline.—Prof. Swale Vincent and J. H. Thompson: A Respiratory Autacoid from the Adrenal Cortex Discharged into the Circulation via the Lymphatics.—B. E. Gaissinsky and M. I. Lewantowsky: Changes in Striped Muscle after Sympathectomy.—G. T. Popa and F. Popa: The Sympathetic Innervation of the Skeletal Muscle in the Wing of the Pigeon: its Function and Morphology.—Demonstrations:—G. Briscoe: Experimental Co-ordination of Muscular Movements. (*a*) Grading in Skeletal Muscle; (*b*) Reciprocal Contraction in Antagonistic Muscles; (*c*) Threshold Reaction to Stretch.—G. Briscoe and W. Leyshon: Fork Controlled Neon Lamp Circuit for Excitation of Nerve (*a*) with Induction Coil, (*b*) by Direct Method.—G. Briscoe: (*a*) Friction Gear Apparatus for Driving at any Speed; (*b*) A Glass Exercise in Reciprocal Contraction.—E. F. Hewer and M. F. L. Keene: The Parathyroid and the Pineal at Various Stages of Development in the Human Fœtus.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at College of Technology, Manchester), at 7.—G. Mohn: The Application of the Microscope to the Study of Metals and Alloys.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—J. W. Beaumont: The 'Sentinel' Engine and its Application Railway Work.

MONDAY, DECEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.30.—J. R. Duggan: Suction Gas as an Automobile Engine Fuel.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section) (at the College, Loughborough), at 7.—C. K. Spied: 'Servo-Equipment.'

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (Newcastle-upon-Tyne), at 7.15.—J. Neill and others: Could the Method of Conducting Measured Mile Trials be Improved?

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Technical College, Glasgow), at 7.30.—Dr. H. J. Gough: Recent Developments in the Study of the Fatigue of Materials.

RAILWAY CLUB (57 Fetter Lane), at 7.30.—J. Pelham-Maitland: Recent Developments in Main Line Electrification in France.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—B. Ionides: Modern Glass.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Papers to mark the Bicentenary of Captain Cook, including an Appreciation of his Life written by Sir Henry Newbolt.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Leeds).—Dr. E. G. Ritchie: The Storage of Steam in Industrial Plants.

TUESDAY, DECEMBER 18.

ROYAL DUBLIN SOCIETY, at 4.15.—J. T. Donnelly, C. H. Foott, and Prof. J. Reilly: A Note on Gas Analysis.—Dr. W. R. G. Atkins and Dr. H. H. Poole: The Integration of Light by Photo Electrolysis.

ROYAL SOCIETY OF MEDICINE, at 5.30—General Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 6.—J. H. Nicholson: The Reconstruction of the New Holland Pier.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates' Branch—Manchester and District) (at Milton Hall, Manchester), at 7.—A. B. Crompton: Drying in Laundries.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—B. H. Crawford: Photographic Methods in Nature Study.—Dr. W. Clark: Exhibition of some Kinematograph Films (subject to their arrival from America in time for the mee[illegible]

INSTITUTION OF AUTOMOBILE ENGINEERS (at Bi[illegible]gate Café, Coventry), at 7.15.—L. H. Dawtrey: Automobile Brakes.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—H. A. D. Acland: The Kitson-Still Locomotive.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Engineering and Scientific Club, Wolverhampton), at 7.30.—L. H. Pomeroy: Modern Problems of Engine Lubrication.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Miss R. M. Fleming: A Study of Growth in Children: its Ethnological and Educational Significance. An Analysis of Six Years' Consecutive Measurement.

WEDNESDAY, DECEMBER 19.

SOCIETY OF GLASS TECHNOLOGY (at University College), at 2.30.—W. B. Lyttleton: A Brief Outline of the History, Development, and Methods employed in the Manufacture of Laminated Glass.—J. Randall and R. E. Leeds: (*a*) A Simple Test for the Detection of Iron Oxides in Glass Sands, and (*b*) Note on the Reduction of Glass in Hydrogen.

ROYAL METEOROLOGICAL SOCIETY, at 5.—L. H. G. Dines: The Dines Float Barograph.—Dr. J. Glasspoole: The Distribution of the Average Seasonal Rainfall over Europe.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF [illegible] TECHNOLOGY (at 17 Fleet Street), at 5.30.—E. C. Curwen: Agriculture in Britain.—H. O. Clark: Notes on French Win[illegible]

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. C. A. Matley: A Visit to the Crater of Papandajan (Java).—Dr. W. J. Pugh: The Geology of the District between Llan-y-Mawddwy and Llanuwchllyn (Merioneth).

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—I. W. G. Freeman: The Harbour Improvement Scheme at St. Peter Port, Guernsey.

LIVERPOOL ENGINEERING SOCIETY (at 9 The Temple, Liverpool), at 6.30.—J. D. G. Taylor: Some Aspects of Railway Construction in Benguela.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Engineers' Club, Manchester), at 7.—J. O. H. Norris: The Design of a Town Carriage.—F. H. Paul: Suggestions relating to the Design of Automobiles.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.

ALCHEMISTS' SOCIETY (in Chemical Lecture Theatre, Glasgow University), at 7.30.—Dr. H. Hepworth: The Chemist in Industry.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Section) (at Queen's Hotel, Birmingham), at 7.30.—W. G. Copestake: Two-stroke Engines.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—E. Heron-Allen and A. Earland: Some Further Notes on the Pegididæ.—Prof. E. Ghosh: A New Parasitic Ciliate from the Intestine of the Bengal Monkey (*Macacus rhesus*).

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London), at 8.30.—Dr. E. Glover: The Psychology of the Psychotherapist.

THURSDAY, DECEMBER 20.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—J. Swinburne: The Work of Sir Joseph Swan (Lecture).—E. B. Wedmore, W. B. Whitney, and C. E. R. Bruce: An Introduction to Researches on Circuit Breaking.

CHEMICAL SOCIETY, at 8.—Prof. C. K. Ingold and C. C. N. Vass: Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions. Part II. Mechanism of Exhaustive Methylation (continued).—G. W. Fenton and Prof. C. K. Ingold: Influence of Poles and Polar Linkings on the Course Pursued by Elimination Reactions. Part III. A Decomposition of Dialkylsulphones.—Prof. G. T. Morgan and R. A. S. Castell: Researches on Residual Affinity and Co-ordination. Part XXXI. Molybdyl bis-β-diketones.—Prof. G. T. Morgan and F. H. Burstall: Interactions of Selenium Oxychloride and Phenols.—Prof. C. K. Ingold and E. Rothstein: Influence of Poles and Polar Linkings on Tautomerism in the Simple Three-Carbon System. Part I. Experiments illustrating Prototropy and Anionotropy in Trialkylpropenylammonium Derivatives.—Dr. S. Sugden: The Parachor and Chemical Constitution. Part X. Singlet Linkages in Chelated Co-ordination Compounds.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—E. G. Herbert: Cutting Tools Research Committee: Machinability.

INSTITUTION OF MINING AND METALLURGY (at Geological Society).

FRIDAY, DECEMBER 21.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.—C. H. Hudson: Oils for Cutting and Quenching Purposes.

PUBLIC LECTURES.

MONDAY, DECEMBER 17.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—F. L. Engledow: The Breeding and Growing of New Kinds of Corn.

TUESDAY, DECEMBER 18.

UNIVERSITY OF LEEDS, at 8.—R. G. Collingwood: Recent Progress in our Knowledge of Hadrian's Wall.

CONFERENCE.

FRIDAY AND SATURDAY, DECEMBER 14 AND 15.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at University College).

Friday, Dec. 14.

At 10 A.M.—E. C. Barton Wright and J. E. Boswell: The Bio[illegible] K. Cannan: Glutathione Considere[illegible] Pinhey: Tyrosinase in Crusta[illegible] J. C. Drummond: Comparativ[illegible] Experiments on Bios and Yeast Growth.—R. N. Salaman: Adventitiou[s] Buds and Mutations in the Potato.

At 2.15.—Dr. H. A. Harris: The Contrast between Vegetative Proliferation and Differentiation in Function.—Dr. E. Bozler: Some Relation between Structure and Function in Muscle Fibres.—Prof. J. B. Gatenby and S. Wigoder: Notes on the Cytology of X-radiated Cavy Testes.

Demonstrations.

A. N. Mukerji and Prof. J. B. Gatenby: Golgi Bodies, Vacuome and Mitochondria *intra vitam*.—Dr. E. Bozler: The Relations between Structure and Function in Muscle Fibres.—Miss E. M. Renton: The Rearing of Marine Animals.—Dr. H. P. Hacker and Dr. H. S. Pearson: The Position Assumed by Anopheline Larvae at the Surface of Water and its Mechanism.—Dr. H. A. Harris: Vegetative Proliferation and Differentiation in Function in Bone.—Prof. P. A. Buxton and Dr. V. B. Wigglesworth: Methods of Rearing Blood-sucking Reduviidae in the Laboratory.

At 4.45.—P. Gorer: The Crustacean Neuromuscular Apparatus.—Miss S. M. Mills: The Effect of pH on the Ingestion of Food by Colpidium.

At 6.—Annual Meeting.

Saturday, Dec. 15.

At 10 A.M.—C. F. Marrian and Dr. A. S. Parkes: The Effect of Anterior Pituitary Injections on Dietary Sterility.—E. A. Spaul: The Biological Activity of the Anterior Pituitary and the Phosphate Content.—H. O. Bull: [illegible] of Fish Behaviour.—B. P. Wiesner: Pseudopregnancy. Its Biological Significance and Mechanism.—V. J. Clancey: Exhibition of Biological Cinema Films.

SATURDAY, DECEMBER 22, 1928.

CONTENTS.

Air Survey and Empire Development.

THE growing call for the application of scientific knowledge in the development of the resources of the British Empire has found one response in the increased attention which is being paid to the survey of the Dominions and Colonies. In July last a conference of Empire surveyors was held in London. This was the first conference of its kind, and marked a great forward step in the mapping of the Empire. On that occasion the Secretary of State for the Dominions and Colonies emphasised the importance of maps in facilitating the development of new countries. A great deal has been done in late years, but only about 20 per cent of the Empire has been actually surveyed by modern methods on even comparatively large scales.

In a recent lecture to the Dominions section of the Royal Society of Arts, Col. H. L. Crosthwait dwelt on the value of air photography in this connexion. Ground surveys are slow and laborious. In many of the larger areas of the Empire, even if the steady flow of funds is available, years must elapse before the accurate maps made by topographical surveyors are available. Forest lands, which are numerous in many parts of the Empire, are difficult to survey and mean slow progress. Rugged and inaccessible areas present other serious problems. Most of these difficulties disappear when aerial survey is employed. A recent example was the speed with which certain forested deltaic lands in Burma were mapped by air, the whole occupying a few days instead of as many months. Air survey is being used effectively and comparatively cheaply in many parts of the Empire, and at home the Ordnance Survey has shown its value in the revision of maps. The prevalence of air survey in the future may even effect a change in the style of maps. The photographic map on which certain features are strengthened may replace the plan in town surveys. It would have its value in maps where the indication of the details of surface relief was not an essential.

The production of accurate large-scale maps is the aim of every survey department, but the work is necessarily slow even after the observations have been taken. The maps will be available in the course of time, but meanwhile the development of the Empire proceeds, and air photography can be of great assistance in reconnaissance and preliminary or local surveys for various purposes.

Col. Crosthwait spoke of various aspects of the work that have an immediate value in the development of new lands. He showed how a photographic survey of possible routes of a new railway through unmapped country might be of great service to the engineer who had to decide which

be surveyed in detail. The faulty alinement of a railway has more than once been a source of serious expense to a colony, and its avoidance by ground surveys of several possible routes is not only a costly matter but also always entails the possibility of the best route being overlooked if a feasible one be found. For such a purpose no detailed work is required until the engineers have chosen the most useful route, which then of course has to be surveyed in detail. Air photography has also been used with success, particularly in the United States, in coastal surveys for the exploration of obstructions to navigation in deltaic waters and on rocky coasts. Aeroplanes have been employed by the government of Canada in surveying the distribution and movements of ice in Hudson Strait in connexion with the opening of the new trade route via Hudson Bay to Churchill, which is to be a wheat port for the west of Canada.

Air survey can also be used in the investigation of water-power development, and water storage for irrigation purposes. The feasibility of a power scheme based on the storage of water which necessitates the submergence of large areas of land can be ascertained by stereoscopic photographs. They provide the preliminary reconnaissance at a low cost and in a short time. The photographs taken for the preliminary investigations can then be used for the final plans merely by the addition of ground control. The location surveys required for electric power cables and pipe lines can rapidly be made from the air.

Air photography can also supply much useful information with regard to mineral resources. It cannot be used for detached geological survey, but it can give geological indications by means of land forms which will afford useful suggestions to the surveyor and point to localities where close investigation might be profitable. Air photographs of vegetation serve as a useful guide in a survey of soils and the possibilities of cultivation of various crops, and in forest survey they serve to indicate areas of value for commercial purposes. As a result of recent work in Northern Rhodesia, during which air surveys were extensively used, Mr. R. Bourne, of the Imperial Forestry Institute at Oxford, emphasised all these among other uses to which air photographs can be put.

The aeroplane has also been found useful in combating insect pests. Successful operations in the cotton fields of the United States prompted the Canadian authorities to try the experiment of [illegible] an aeroplane over spruce [illegible] Nova Scotia. The first year's experiments [illegible] very [illegible] in fact, a wide scope for the use of [illegible] of the Empire quite apart from the transport facilities they provide. They afford another example of the value of scientific application in the development of the resources of new lands, and can be employed for many useful purposes at comparatively small cost.

Evolution and Fundamentalism.

THE illegitimate use of the minor discussions of scientific workers to cast doubt upon the whole question of evolution is well known and can be guarded against only by extreme caution in our words. This is illustrated in an article in the Catholic review, *America* (Nov. 10, 1928), entitled "Neanderthal—a Slippery Ancestor." The writer pits against each other the views of Hrdlička and Elliot Smith (with quotations from NATURE) regarding the significance of Neanderthal man in human evolution, and because a divergence of opinion exists, he suggests that science should be looked on askance. "Draw up to the curb of common-sense and Revelation," he says, . . . "because very often 'scientists' are but a 'We-Too' gathering, all, despite their protestations of independent thinking, following some leader in beating the tomtom of Evolution." But, of course, on the fundamental question of evolution or non-evolution amongst all living things, including man, the two distinguished scientific workers named are in agreement.

While such articles show that the fire of dissent is still alight, a recent *Daily Science News Bulletin*, issued by Science Service of Washington, points to a distinct smouldering at the present time. In universities and other centres of higher education in Tennessee and elsewhere, anti-evolution legislation is "more honoured in the breach than in the observance," but in the lower schools, particularly in smaller places, no amount of theoretical freedom of teaching can prevent local school boards from rejecting candidates for positions when they do not approve of their theological views. Biologists have come to accept these two conditions as actualities of their profession.

Since the Scopes trial at Dayton, Tennessee, in 1925, no serious effort has been made to get a test case of the anti-evolution statutes in Tennessee or Mississippi, the only two States which have passed such laws up to now. Perhaps this is partly due to the indefiniteness of the law itself, for in its decision on the appeal of the Dayton case, the Tennessee Supreme Court rendered three distinct opinions, all of which left the interpretation of the law in a state of confusion. In spite of this enforced truce, it would be unwise, however, to imagine that the smoking flax of anti-evolutionism is anywhere near the quenching stage.

By an overwhelming majority Arkansas has adopted an anti-evolution law, so that it is now

illegal in every tax-supported school of the State to teach that "man has ascended or descended from any lower order of animals." Furthermore, it is believed in well-informed circles in the United States that if similar anti-evolution laws were submitted to popular referendum in every other available State, the result would in every case be the same under present conditions. There are nineteen other States open to fundamentalist attack by way of initiative and referendum, and in due course each is to be tackled.

One of the present conditions with which the journal *Evolution* finds fault is the aloofness of the body of men of science. In Arkansas, according to a leading article, they kept silent, under the idea partly that "the way to defeat the anti-evolution law is to keep the people from finding out what evolution really means," and partly that what "the masses" think or believe is of no consequence. The first notion surely cannot be held by any true man of science, but the second is familiar enough. Yet it cannot be justified, for it indicates a lack of social responsibility, and may lead to a very real curtailment of the opportunities of science through the pressure of the very masses whose education is wilfully ignored.

The plea of the fundamentalist is a practical one—the old story of he who pays the piper calls the tune. The only way to meet such opposition is not by raking up an equal number of adverse votes, but by enlightenment, and that is a slow process unless the men of science as a body are prepared to leave the laboratory bench and go out into the wilderness preaching their gospel of truth and progress.

We are of opinion, however, that *Evolution* tends to follow a line of propaganda which must have unfortunate reactions. It must be assumed that the fundamentalists are sincere in their views. Sarcastic references and polemic articles can only embitter the contest. The old ideas have a strong hold and have behind them the sanction of ages: only by gentle stages can they be shaken, and the science propagandist must temper his wind to the shorn lamb of fundamentalist ignorance.

Nevertheless, the conclusion reached by *Evolution* is sound. If ignorance is to be dispelled before the mischief is done, "every opportunity should be utilised to educate the public as to what evolution means." "Not only through the class-room, but also through the platform, radio, movie, magazines, and newspapers, ten thousand spokesmen of science should lift their voices, so that an understanding of the method of science may replace popular superstition and bigoted belief." But are thousand, nay, one thousand men of science, who can carry on the propaganda as it should be carried on to win a popular victory?

Eugenics Now and Hereafter.

(1) *Organic Inheritance in Man.* (University of Birmingham, Faculty of Medicine: William Withering Memorial Lectureship.) By Dr. F. A. E. Crew. Pp. xxviii + 214. (London and Edinburgh: Oliver and Boyd, 1928.) 12*s.* 6*d.* net.

(2) *Being Well-Born: an Introduction to Heredity and Eugenics.* By Prof. Michael F. Guyer. Second edition. Pp. xv + 490 + 9 plates. (London: Constable and Co., Ltd., 1928.) 21*s.* net.

HERE we have two more works added to the long list, which claim to enlighten man on the facts of his inheritance and to indicate—at any rate in brief outline—how these facts may be applied to racial betterment. It has become a custom, almost a necessity, we might say, for every professor of biology, be he zoologist or botanist, to publish a treatise on eugenics. The subject has become fashionable, and his pupils demand instruction; the academic lectures are given, and later the book appears. In the beginning of last century, every medical man, from Erasmus Darwin downwards, held himself to be a trained biologist; in the latter half of the century every anatomist was *ipso facto* an anthropologist, and in this new century every biologist must of necessity publish his views on eugenics.

Biology and anthropology have survived this handling, and it may be anticipated that eugenics will do so likewise and become ultimately a definite discipline with well-defined frontiers, and its own independent academic laboratories, even if they remain in close association with those in which animal genetics, anthropology, medical research, and statistics are topics of investigation. No eugenic investigator can work effectively without some fundamental knowledge on these allied sciences; but it is equally true that a worker in any isolated one of them is not of necessity an authority on eugenics as a science, although he may contribute material which will be of service to the eugenist.

(1) Dr. Crew's book on "Organic Inheritance in Man" embodies the subject matter of a course of lectures he gave in the University of Birmingham to medical men, and especially general practitioners, as the first William Withering Memorial lecture. To those who have read Morgan's writings at first hand, or even are familiar with Baur and Lenz's "Menschliche Erblichkeitslehre," there will be small

Crew's work. But to those who have not,

doubt if pp. 23-92 will form a very lucid introduction to the subject. The author's treatment seems to us to lack the lucidity requisite in a semi-popular lecture, and yet it fails to provide the explanatory detail requisite in a text-book.

This criticism can be easily illustrated. Over and over again we meet with statements that in the present reviewer's opinion are exceedingly doubtful; he knows papers in which they have been made, but he must suppose Dr. Crew to judge his material qualitatively as well as quantitatively, and possibly to have seen unexceptional material of which the reviewer is ignorant. He wishes to turn for information to the sources from which the statements are drawn. The reviewer's case must be that of many readers, and it is not in one, but innumerable examples, that this desire will arise. Not a single authority is quoted in the book, but the reader is told that the references if desired by the reader can be obtained from the author! For example, in the list of hereditary human defects on pp. 139-144, we have had to place queries requiring further information in between thirty and forty cases, where the statement seems to us doubtful. It is not feasible to give a list of these, and one illustration must suffice: "split hand," we are told (p. 144), is *recessive*, "split foot" is *dominant*. Now we happen to know a woman with both hands and feet split, who married a normal non-consanguineous husband; some of her children are normal, some have either split hand or split foot, and some have both. Those who have studied such cases know how highly correlated the two conditions are, and that one should be a Mendelian recessive and that the other should be a dominant, certainly requires some very weighty authority to be cited before a reader acquainted with the facts can accept such a statement.

As another illustration of where we want much more enlightenment, let us take the case of a single pedigree of twinning on p. 199. There is no doubt the family is a twinning family—we have seen many such pedigrees. There are six pairs of twins in this family; in only one case is there a cousin marriage; in the other five cases, in order to draw the inference that twinning is recessive, we must suppose that the members of the family married into other twinning families. This involves the occurrence of as much assortative mating in twinning families as exists among deaf-mutes! Indeed, little can be learnt from a collection of selected isolated pedigrees such as Dr. Crew provides on pp. 184-212. We need to analyse *many* pedigrees of each class of defect before we can assert that a particular defect obeys Mendelian laws, which involve of necessity Mendelian average ratios. Looking at a single short pedigree, it is generally easy to assert that the disease is recessive or dominant, though it becomes somewhat unsatisfactory when we find one and the same disease in three different small pedigrees labelled: Dominant, all affected individuals heterozygous, recessive, and finally recessive, sex-linked. Indeed, the number of pedigrees Dr. Crew describes by the words "all affected individuals heterozygous," makes one wonder how one can be certain of the existence of dominance at all in these cases. When the Mendelian theory does not work very well, then the pedigrees are labelled as in the case of epilepsy: dominant (irregular), which certainly leaves us free, as on p. 141, to find that epilepsy may also be recessive and sex-linked.[1]

Albinism, we are told, is a recessive, but what actually determines that an individual is an albino we are not informed. Possibly when two albinos breed true, they are true albinos, and when they do not, then they are not. But this is not very helpful for *a priori* prediction, or as a physiological definition of albinism from which the genetic rules as to albinism follow *ipso facto*.

The general practitioner called upon to advise with regard to a particular marriage might well feel somewhat puzzled were he to seek help from Dr. Crew's work! He might, for example, read such a passage as the following:

> "Cancer in the experimental animals is, in all respects, the same disease as cancer in the human. The fundamental laws of genetics apply to all forms, experimental animals and men alike. Many records of human cancer point to the conclusion that its mode of inheritance is the same as that which obtains in the case of cancer among experimental quickly reproducing forms. Other characters, normal and abnormal, are inherited in a significantly orderly fashion in the human, and so there is reason to hold that the human hereditary mechanism is the same as that which has been shown to exist in experimental forms" (p. 172).

This appears a clear-cut and logical statement, and the general practitioner will next expect to be told what is the hereditary mechanism of cancer among experimental quickly reproducing forms. Instead of that he will read on:

> "The statistical data concerning cancer can be reconciled with the finding that the tendency to develop cancer is a genetic recessive character. It should be stated, however, that there are

[1] A similar case is that of myopia, which is recessive according to Clausen, and dominant according to Jablonski.

[d]egrees in which carcinoma of the stomach [m]oves in inheritance as a dominant."

All references, as usual, are missing. Some statisticians have failed to find any inheritance of cancer in man; Levin found evidence of resistance to cancer being a Mendelian dominant, while other inquirers content themselves by stating that various families possess different degrees of susceptibility. Where are the precise genetic laws which cancer follows in quick-breeding mammals to be found? We refer the general practitioner to the papers of Miss Maud Slye, and, if he has a logical mind, we believe he will agree with us that, for lack of necessary information, her vast experimental researches fail to provide those precise genetic laws which are supposed to govern cancer in mice and men. Once admit that individual families or stocks can possess every grade of susceptibility to cancer from 0 per cent to 100 per cent, and the reconciliation of this result with a simple dominant or recessive Mendelism becomes very obscure. To make susceptibility to cancer a unit character appears to the present reviewer as unwise as to force that finely graded character feeble-mindedness into the same category. It is covering our ignorance by a verbalism, which may check further inquiry into the complicated conditions under which these abnormalities and pathological tendencies are actually inherited.

There is much good material in Dr. Crew's last chapter, which, if not novel, is often well put; for example:

"The supreme duty of society is to weed out its worst qualities and to nurture its best. Racial improvement is to be achieved under conditions in which the physical and intellectual improvement of the individual does not interfere with his racial and ethical obligations and in which the promotion of human betterment is undertaken by society as its greatest work. Individual improvement is a necessary concomitant of racial betterment, and the first duty of the individual is to transmit unimpaired and undefiled a noble heritage to generations yet unborn" (p. 177).

The only comment we have to make on this is that all racial and ethical obligations are relative to their age, and our conception of moral and national duties will be remoulded step by step as eugenic principles become more widespread. Incest in a family with manic-depressive insanity will remain for ever a crime; it might actually become a virtue, a national duty in the case of a family of surpassing genius, which had a sound and healthy pedigree.

The book is preceded by an interesting biography and portrait of William Withering, M.D. (1741–1799), which carries us back to the days of Samuel Galton, Erasmus Darwin, Priestley, and the Lunar Society.

(2) The second book on our list is by the professor of zoology in Wisconsin. It is a more ambitious work than that of Dr. Crew, being intended as an elementary text-book of heredity and eugenics. It suffers, however, from some of the defects of the latter; thus, while it takes a step in advance by giving the *names* of investigators, in very many, possibly the majority of cases, there is no reference to the locus of the original researches. Yet even with its greater price, we believe Guyer's work would be the more serviceable of the two to the medical man seeking to know the bearing of eugenics on his own field of activity. On the other hand, to the reader impartial as to any theory of heredity as long as it suffices to describe the observed facts, there is as usual much in Guyer's as in Crew's work to which exception must be taken; in both cases it arises from the common Mendelian training, which too often fails to recognise the extreme limitation at best of the independent unit-factor hypothesis. Let us cite a few lines from p. 14.

"A tremendous impetus was given to the method of experimental breeding when it was realised that we can itemise many of the parts or traits of an organism into entities which are inherited independently one of another. Such traits, or as we have already termed them unit-characters, may be not only independently heritable, but independently variable as well. The experimental method seeks to isolate and trace through successive generations the separate factors which determine the individual unit-characters of the organism" (p. 14).

We could wish that Prof. Guyer would 'itemise' the skeletal parts of any organism, most of which are very highly correlated with one another. Does each bone correspond to a unit-factor, or is there a determiner for the skeleton as a whole? If the latter, then how can 'lobster claw' affecting some twenty to thirty bones of the skeleton only be a unit-factor? If the former, how can we speak of unit-factors being independent, when it is clear that in perhaps the most fundamental part of the organism they are highly dependent one on the other? And, be it remembered, the soft parts must be highly correlated with the skeletal—indeed, it is the brain which determines the brain case. In truth, Horatio, there be many things undreamt of in thy philosophy! Would it not be better at an early stage to hint to the puzzled beginner that

independent unit-characters can carry us only a very little way when we come to study the heredity of abnormalities in man. There is small illumination to be obtained by classifying such abnormalities even of the same class by different Mendelian terms according to the isolated individual pedigree !

Guyer sees, however, further than Crew ; he endeavours to give some account of statistical methods, and preaches the excellent doctrine that "Intelligent combination of all methods—embryological, experimental, statistical—is necessary in modern genetics" (p. 23). But, alas ! his practice is worse than his profession, for he writes :

> "Since, in spite of Galton's attempt to establish a hypothetical mid-parent, there is no satisfactory method of determining in a single measurement the relation between children and both parents, it is obvious that information derived from the coefficient of correlation between child and parent is deficient in that it takes into account only one parent. The correlation with the other parent, though just as important, has to be determined separately" (p. 22).

The astonished statistician will ask : How comes Prof. Guyer to write on evolution and eugenics, which must inevitably deal in large part with mass changes, if his statistical knowledge has stopped short of multiple correlation ? Can he be unaware that the formula for biparental inheritance, or indeed for inheritance from any number of ancestors, is just as valid, or just as invalid, as that for a single parent ? They stand on exactly the same theoretical basis. We fear he has had no training in the tool he professes to describe, for on the very same page he seems to think that the statistical method cannot discriminate between the effects of environment and heredity ; he suggests that knowledge on this point can only be gained by direct experiment on animals. This not only indicates that the author is essentially ignorant of such a powerful tool as partial correlation, but also of all the literature which has been published on the relative influence of heredity and environment in man. Indeed, the influence of environment as a quantitatively determinable factor scarcely appears in the work ; it is only discussed in the chapters which deal with the problem of whether somatic characters are inherited—good readable chapters, we may remark, and written without dogmatic partisanship.

The same may be said of our author's treatment of the pure line. It is true that he does not appear to have read the fatal criticism made of Johanssen's original research and of later investigations on *Hydra*, namely, that the pure line theory demands that the offspring shall be as highly correlated with the grand-maternal or the materteral organism as with the maternal, and that this condition was satisfied in neither case. Prof. Guyer describes Jennings's researches on *Paramecium*, which were widely supposed to have firmly established Johanssen's conclusions. He gives, however, the remarkable recantation provided by Jennings himself as a result of his later experiments on *Difflugia*, who summarised his results in the words :

> "The hereditary variations which arose were of just such a nature as to produce from a single strain the hereditary strains that are found in nature."

The results from *Difflugia* were more significant than those from *Paramecia*, because of the greater abundance and definiteness of the characters of the former. Yet the pure line still continues to flourish in many text-books, it being invariably easier to propound a theory than to kill it. It must be a satisfaction, however, to those who have faith in the power of statistical methods, to know that their criticism of the pure line hypothesis on the basis of the propounders' own data has been justified, and that Jennings and his pupils have demonstrated that at least for certain species where the variations are as continuous as can be detected, it is possible to create separate true breeding strains from a 'pure line.'

Much of the earlier part of Prof. Guyer's book is given up to a repetition of the familiar facts of reproduction, development, and elementary cytology, all, however, put with considerable lucidity and good illustrations. Then follow seventy pages of simple and complex Mendelism as applied to various characters in different organisms. Here the reader will feel in smaller or greater states of doubt according as he has not or has conducted similar experiments himself. The statements and diagrams are conventional, but are clearly, if occasionally with slight dogmatism, restated. Prof. Guyer is the redoubtable Michael, rather than the doubting Thomas !

When our author comes to deal with human heredity, we regret to find that he is as distinctly uncritical as Dr. Crew. He largely accepts without questioning. The present reviewer once asked a distinguished zoologist why he had incorporated into his work results which a little inquiry would have shown him to be idle. He replied : "Because in biology we unhesitatingly accept the results of our

fellow-workers, until they are demonstrated to be false by another of us." It is this lack of a healthy spirit of doubt, of sane criticism, which seems to us the root of much evil in works of the present kind. Let us illustrate it; we cite from p. 202:

"*Eye-colour in Man.*—Of normal characters in man which follow the Mendelian formula perhaps eye-colour is the best established. Brown or black eye-colour is due to a *melanin* pigment absent from the blue or grey eye. That is, a brown eye is practically a blue eye plus an additional layer of pigment on the outer surface of the iris. The different shades of brown are due to the relative abundance of this pigment. Grey colour and the shades of blue seem to be a modification of an original dark blue, due to structural differences in the fibrous tissues of the iris."

Then follows, as in Crew's work, the usual interpretation of the brown eye being dominant and the blue eye with its lack of anterior pigment being recessive. No authorities *whatever* are cited for this 'best established' example of Mendelian inheritance; only later Winge is mentioned as a hint that this is not quite the whole story. Now what is really the history of this "best established" example? So far as we know, Alphonse de Candolle, in Geneva in 1884, was the first to make the statement about brown-eyed parent mating with brown-eyed parent in certain cases giving only brown-eyed children. His material was collected from France, Switzerland, Sweden, Germany, etc., and his correspondents were requested to leave out parents whose eyes were not distinctly brown or blue and families with doubtful eyed children! Further, as he paid no attention to earlier ancestors, and neglected the marked racial differences of his population, he not unnaturally failed to convince anybody. Next, in May 1886, Galton took the matter up, and collected by aid of schedules a vast amount of material from English middle and upper class families, reaching in a number of cases to four generations. Then Mendelism became the mode; the fact that there are blue-eyed races which breed true, and brown-eyed races which do so also, suggested that this might be an easy and popular illustration of the simplest form of Mendelian theory. Galton's material was investigated from this point of view and failed to obey Mendelian theory.

Davenport in the United States next proceeded to collect material—apparently by issuing schedules in Galton's manner—and came to the definite conclusion that eye colour *did* obey this theory. Shortly after, Hurst came upon the scene, and stating that it is impossible to judge by mere inspection whether an eye has anterior pigment or not, used a lens to answer this question. He established to his own satisfaction the Mendelian character of eye colour; the lack of anterior pigment as judged by a lens, denotes that the eye is true blue and that the zygotes of that individual are Mendelian recessives. Now Davenport and Hurst are the authorities on whom this "best established" example is founded, and when any reference is given at all for it in the elementary text-books, which is not frequently done, they are cited indifferently, although Hurst had repudiated Davenport's method, that of macroscopic inspection, as incapable of determining the absence of anterior pigment.

Quite a number of years ago the present reviewer asked a distinguished ophthalmologist with a large hospital practice to examine most carefully both eyes of blue-eyed patients with a lens, and when no anterior pigment whatever could thus be found, then when one eye had to be excised, to preserve it for examination. In this way some dozen blue eyes were obtained, sectioned, and examined microscopically. In no *single* case was there an entire absence of anterior melanine pigment granules. What, then, is a true blue eye? Does the eye begin to be recessive when only a certain grade of pigmentation just not ascertainable by a lens—and a lens of Hurst's magnification—occurs? The difficulty is just the same as in the corresponding definition of the albinotic eye as an eye possessing no melanine pigment at all. Albinos of nearly all species (mouse so far excepted) show such pigment, if in some cases in small quantities, and yet as a rule breed true.

So long as eyes exhibit every grade of pigmentation, we are not at the bottom of the laws of eye-colour inheritance, when we try to force them into the categories of simple dominance and recedence. If this is perhaps the "best established" example of the application of Mendelian theory to man, what must we say of its application to abnormalities, not to cite such diseases as cancer and tuberculosis? Of a truth, fashion in science is often its greatest danger; men, instead of searching deeply into the original facts and seeking for their explanation, blindly apply the current notions to ill-digested data, simply because a greater mind has propounded a novel truth and, perhaps, after all only a half truth.

We cannot, however, leave Prof. Guyer at his chapter on "Human Inheritance" without a word of high praise for his final chapters on prenatal

influences, human conduct, crime and race-betterment. Therein he shows himself an enthusiastic if sober advocate of eugenics.

"Shall we as a people continue to be confronted at every turn by the dull countenance of the imbecile, the inevitable product of a bad parental mating, or the feeble body and clouded intellect of the child sprung from a parentage of polluted blood; or the furtive cunning of the young delinquent, the will-less mind of the born degenerate, or the shiftless spawn of the pauper? Or shall it be a type with laughing face, with bounding muscles, with unclouded brain, overflowing with health and happiness—in short, *the well-born child*?

"The answer is in our own hands. The fate of many future generations is ours to determine, and we are false to our trusteeship if we evade the responsibility laid before us. How conscientiously we heed known facts, how actively we acquaint ourselves with new facts, and how effectively we execute the obvious duties demanded by these facts will give us the answer" (p. 441).

These are not mere fine words from Prof. Guyer; the careful reader of his book will find that if it does not lack faults there is at back earnest conviction. He reaches the boundary whereat eugenics passes from science to a national faith, or what Galton termed the true religion of the future. Here, at least, we feel entirely in unison with his statements.

KARL PEARSON.

The Geology of Africa.

Geologie der Erde: Geologie Afrikas. Von Prof. Dr. Erich Krenkel. Teil 1. Pp. x + 461 + 22 Tafeln. (Berlin: Gebrüder Borntraeger, 1925.) 34·50 gold marks.

STUDENTS of African geology are under a great debt of gratitude to Prof. Krenkel for his masterly summary of its scattered and polyglot literature. The first of his three volumes begins with a general survey of the physiography and geology of the continent as a whole, and then deals in detail with the north-eastern and eastern areas and the African islands of the Indian Ocean. The second volume is devoted to South Africa, and the third will apparently cover west equatorial and north-western Africa. The book is the result of an exhaustive study of the literature which has been digested with such critical and cautious judgment that it helps the interpretation of the evidence as well as its systematic arrangement and tabulation.

The first chapter summarises the physical features of Africa and divides the continent into three sections—the African Highlands, which include all the eastern and southern parts of the continent; the African Lowlands, which include the basins of the Congo and of north-western Africa, and the intervening uplands; and 'Little Africa,' which consists only of the Atlas region. The relief of the continent is related to that of the adjacent oceans, and an instructive diagram shows that the distribution of the main oceanic and continental depressions is like the spaces in a network; from this arrangement Prof. Krenkel infers their formation by subsidence between more stable intervening bands.

This explanation of the distribution of the Atlantic deeps agrees with the view of Leuchs that they are due to vertical subsidence rather than with that of Pratjé, who holds that they are dependent upon crustal folds. The South Atlantic basin, Prof. Krenkel declares, has not been a permanent feature in the earth's geography. He says it dates only from the Cretaceous, although he accepts (p. 24) the entry of a Permian sea into the South Atlantic on the evidence of some reported marine rocks in south-west Africa. The occurrence of these marine fossiliferous beds overlying the Upper Palæozoic glacial beds would be so important that it is unfortunate that the evidence is not fully convincing; but its acceptance by Prof. Krenkel shows that more weight should be attached to it.

The sections of the continent dealt with in the first volume are divided into Egypt and Nubia, Abyssinia and Somaliland, and eastern Africa, including Kenya Colony, Uganda, Tanganyika Territory, Portuguese East Africa, and Nyasaland. There are also chapters on the African islands in the Indian Ocean, and on the economic geology. The author includes in this volume, as geologically African, Syria, Palestine, and Arabia, which he groups under the composite name of Syrarabien. The inclusion of this region enriches the volume with its frontispiece and other aeroplane photographs of the Wadi Araba, the land continuation of the Gulf of Akaba. These illustrations well show the features of the East African rift valleys.

The author's judgments on the major problems of African geology are noteworthy. Thus the theory that the Atlantic was formed by the westward drift of South America away from Africa is rejected emphatically. In his discussion of the nature of the Rift Valleys he concludes that they are all due to 'Zerrung' (p. 240), and he describes them as bounded by faults which are always normal and not reversed. He rejects the view of Uhlig that some of the fractures that bound these valleys are overthrust faults. He remarks that the tectonic

origin of the rift valleys is proved alike by the evidence of earthquakes, gravity anomalies, and volcanic distribution. He contrasts what he terms the 'Zerrungstheorie' against the 'Antiklinaltheorie,' which he attributes to de Martonne.

The distinction between the two theories is not clear. The explanation put forward by the reviewer in 1896 was that the rift valleys were due to a raised band of country that extended north and south throughout East Africa, having been torn asunder by parallel fractures, along which bands of the crust subsided. As remarked later (*Geog. Jour.*, July 1920, p. 39), Africa, during the formation of the rift valleys, 'was in tension,' and fractures led to the sinking of long strips between parallel faults. The term 'Zerrung' presumably comes from 'zerren,' to pull. If the 'Zerrungstheorie' means that the whole valley is due to the two sides being pulled apart, it would be inconsistent with the facts; for the main formation was due, as is clearly shown by Prof. Krenkel's diagrams, to subsidences between parallel faults. The difference between the two theories appears to lie in the stress laid on the movements before the faulting. The so-called 'Antiklinaltheorie' implies that the rift valleys occur along a broad belt of highland, and therein agrees with Prof. Krenkel's description of the area traversed as 'Hochafrika.' How that 'Hochafrika' was formed is immaterial; it may be described as a geanticline, as Haug has called the area to the east a geosynclinal. Prof. Krenkel's view fully supports the view that the rift valleys are tectonic, and due to tensional fractures on this highland belt.

The section of this volume of most special value is that on Tanganyika Territory, to knowledge of which the author has himself made important contributions. He clearly summarises the excellent work of the German geologists there and the results of the excavations in the Tendaguru area, which have enriched the Berlin Museum with a collection of giant Mesozoic reptiles. In dealing with this region, and also with the Red Sea, Prof. Krenkel gives a valuable account of the gravity surveys and their bearing on the structure of East Africa. The author maintains that the pendulum observations do not show that the ocean floors expose the heavy sima shell. The chapters are each accompanied by a well-selected bibliography, and the book is illustrated by beautiful photographs and many clear diagrams and maps. So far as can be judged from the first volume, the book will take its place as the standard work of reference on the geology of Africa.

J. W. G.

Our Bookshelf.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 245. Abt. 2: *Physikalische Methoden*, Teil 2, Heft 6. *Mikrophotographie.* Von August Köhler. Pp. 1691-1978. (Berlin und Wien: Urban und Schwarzenberg, 1927.) 15 gold marks.

A REMARKABLE library of practical information concerning the methods of biology has for some time been in preparation under the editorship of Prof. Abderhalden, of the University of Halle. Already nearly three hundred parts have appeared or are in the press. This particular part, although devoted to the comparatively limited subject of photomicrography, contains no less than one hundred thousand words. There can be few details of the art and practice of the subject that are not dealt with in this comprehensive compilation.

It is essentially a work of reference, of, however, a readable nature, as the information, which is largely of a descriptive character, is presented without resort to mathematics of an abstruse kind. The work presents a somewhat limited outlook so far as much of the material and many of the illustrations, which refer to the products of one particular firm, are concerned. No knowledge whatever is assumed on the part of the reader. The operation of the simplest mechanical elements usually taken for granted and the arrangements of parts self-evident from the illustrations are described at length. Without adversely affecting its usefulness, the book might well have been reduced to half its size.

No introduction whatever has been provided: the book commences with a mechanical description of a particular microscope equipment. Neither is there any indication of the contents, nor any index—so essential to a work of reference. Presumably for these omissions the editor, not the author, is responsible. Indexes, apparently, are only published on the completion of parts, each of which comprises a considerable number of volumes. Until these are available, the reader must search for the information he requires with only the assistance of the section headings, which do not afford complete guidance.

J. W. F.

(1) *The Book of Woodcraft and Indian Lore.* By Ernest Thompson Seton. Pp. xxiii + 567. (London: Constable and Co., Ltd., 1927.) 7s. 6d. net.
(2) *White's Selborne for Boys and Girls.* Edited by Marcus Woodward. With reproductions of Bewick's Woodcuts. Pp. xvi + 308 + 8 plates. (Oxford: Basil Blackwell, n.d.) 7s. 6d. net.

(1) ONE of the most interesting and informative boy's books we have read. It discusses all manner of subjects likely to touch upon woodcraft, and that in a summary and practical fashion which gives a business-like touch to its instructions and comments. The principles of scouting, the Indian way, its ceremonies and disciplines, signalling, handcraft stunts and makeshifts, the wild life of the woods, tracking animals, the summer camp, and so on;

from every angle the open-air movement is looked upon and guided by hints gained through long experience. Five hundred drawings by the author illustrate the text, and though the work is founded upon an American basis, most of its tips are applicable to scouting in Great Britain, and the remainder are well worth knowing about in any case.

(2) Although Gilbert White's "Natural History of Selborne" used often to be, and may still be, a prize frequently given to schoolboys, we can scarcely imagine that it is received with due appreciation. Neither the form in which the information is cast nor the style of expression is likely to appeal to a boy, who demands either concise and clear-cut descriptions or a Nature tale adventurous and imaginative. Mr. Woodward, having perceived the difficulty, has endeavoured to solve it by reproducing selected passages, in which the text has been simplified, punctuation put to rights, too heavy sentences broken up, and difficult words translated. Some of Bewick's cuts, and eight coloured plates (from Jardine's "Natural History"), illustrate the text; but in spite of all we still have the feeling that boys will fight shy of these leisurely and disjointed observations of the Vicar of Selborne.

An Outline of Comparative Psychology. By Prof. C. J. Warden. (Psyche Miniatures, General Series No. 20.) Pp. 147. (London: Kegan Paul and Co., Ltd., 1928.) 2*s*. 6*d*. net.

IN this work the author gives us a historical account of man's attitude towards the animal kingdom from the earliest ages. Cro-Magnon man appears to have been the first to take an intelligent interest in the animals round him. However, it is not until comparatively recent times that the science of comparative psychology can be said to have become established. Darwin may be looked on as the founder of modern comparative psychology. The author might well have devoted considerably more space to the experimental movement and told us more about the behaviourist school. The most important work of the Russian school under Pawlow dealing with conditioned reflexes is dismissed in a paltry five lines, but the Americans come in for pages of praise. Köhler's work on the mentality of apes might well have received mention if nothing more. Apparently the author is unaware of the results of the study of animal behaviour outside the United States.

Birds at the Nest. By Douglas Dewar. Pp. viii + 271. (London: John Lane, The Bodley Head, Ltd., 1928.) 7*s*. 6*d*. net.

THE title of this book scarcely conveys to the would-be reader what its contents really are. Briefly put, these may be said to be an attempt to prove that every action of the bird is controlled or carried out by instinct and that intelligence does not exist in the bird mind.

The author brings forward a vast mass of evidence to prove his theories, and at first would seem more or less to have succeeded in doing so. The second reading, however, leaves us with the impression that his reasoning is faulty, his deductions wrong, and his assumptions hasty. It is true that he shows—and shows really well—that birds during the breeding season are obsessed with three furores: first, that of producing their kind; second, that of hatching their eggs; and third, that of feeding the young. It is equally true that he proves in very many cases that birds are so completely controlled by these emotions that these entirely override intelligent action. To our mind, however, he fails to prove that instinct is the sole motive power in the actions of birds and that intelligence plays no part in them.

The book is one worth reading and is, perhaps, the best the very hard-working author has yet produced.

Birds of the Ocean: a Handbook for Voyagers; containing Descriptions of all the Sea-Birds of the World, with Notes on their Habits and Guides to their Identification. By W. B. Alexander. (Putnam's Nature Field Books.) Pp. xxiii + 428 + 88 plates. (New York and London: G. P. Putnam's Sons, Ltd., 1928.) 15*s*. net.

THE present volume contains an account of all those birds to be met with on sea voyages throughout the world, its aim being to make possible the identification of these birds by observation alone. On the whole, we may say that the object aimed at has been attained. The descriptions given are such as will enable most people to identify the vast majority of birds they happen to meet with, and Mr. Alexander's book is one which should find a place in the library of every sea-going vessel.

Each bird is dealt with briefly, the numerous diagrammatic illustrations given will be a real aid to identification, whilst some of the photographic illustrations are really beautiful. The get-up of the book is not worthy of its contents, the paper being poor and the letterpress to the plates often cut off by the faulty binding.

Judgment and Reasoning in the Child. By Prof. Jean Piaget, in collaboration with Mlles. E. Cartalis, S. Escher, A. Hanhart, L. Hannloser, O. Matthes, S. Perret, and M. Roud. Translated by Marjorie Warden. (International Library of Psychology, Philosophy and Scientific Method.) Pp. viii + 260. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1928.) 10*s*. 6*d*. net.

AN excellent book. Dr. Piaget gives a very detailed and comprehensive account of investigation into judgment and reasoning as shown by young children. The book forms a supplement to "Language and Thought of the Child." The logical and reasoning powers of children are not simply elementary forms of adult logic and reasoning; they are something different. The logic of the child is almost entirely ego-centric; it is more closely allied to the autistic or dereistic type of thinking, a conception which we owe to the psychoanalytic school. The child's powers of reasoning are very limited, and it is not until the age of 11-12 years that anything approaching sound formal reasoning appears.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A New Type of Low Frequency Low Voltage Discharge in a Neon Lamp.

IN recent years a good deal of work has been done on the neon lamp as a means of producing oscillatory discharges of high frequencies. The arrangement for this purpose usually consists in placing a variable condenser in parallel with the two electrodes inside the lamp and connecting this in series with an adjustable resistance to a supply of D.C. voltage. The phenomenon of periodic 'flashing' owes its existence to the peculiar characteristics of the neon lamp, namely, to the fact of its having two 'critical' voltages. When the voltage across the condenser and the lamp in parallel approaches a value equal to that required to start a flash, a flash is visible. During the flash, the resistance of the gap falls and so does also the P.D. between the electrodes. The flash, however, does not disappear until the P.D. between the electrodes falls below the lower critical voltage. As soon as the flash ceases the condenser again begins to charge up to the upper critical value, and the process is automatically repeated. This explanation was given by Mecke and Lambrez (*Phys. Zeit.*, **27**, 86; 1926). Using the above arrangement, periodic discharges of high frequencies have been obtained by a number of workers.

The experiments described in this note are of an entirely different nature, since they require no variable

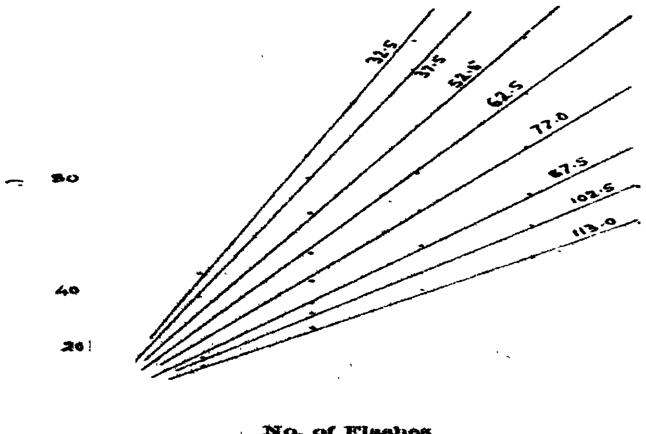

FIG. 1.—Curves showing the great regularity of the flashes. The period of flashing depends on the potential difference between the electrodes.

condenser and can be performed with sufficiently low voltages. Further, the discharges are very slow, and their period can be varied at will.

The arrangement consists in tapping the necessary P.D. from a potentiometer circuit connected to 230 v. D.C. The neon lamp was of the 'I' type with a small rod and a small plate for its electrodes. It was observed that flashes of a regular period appeared at voltages below the upper critical value, when the outside of the bulb was earthed. The hand, which was at first seen to serve this purpose, was later on replaced by a surer mode of contact by immersing the bulb in conducting water and the water was connected to earth. Flashes made their appearance only when the earthing switch was on and not otherwise. The fair regularity of the periodic appearances of the flashes can be judged from the straight linear character of each of the lines in Fig. 1. Different voltages across

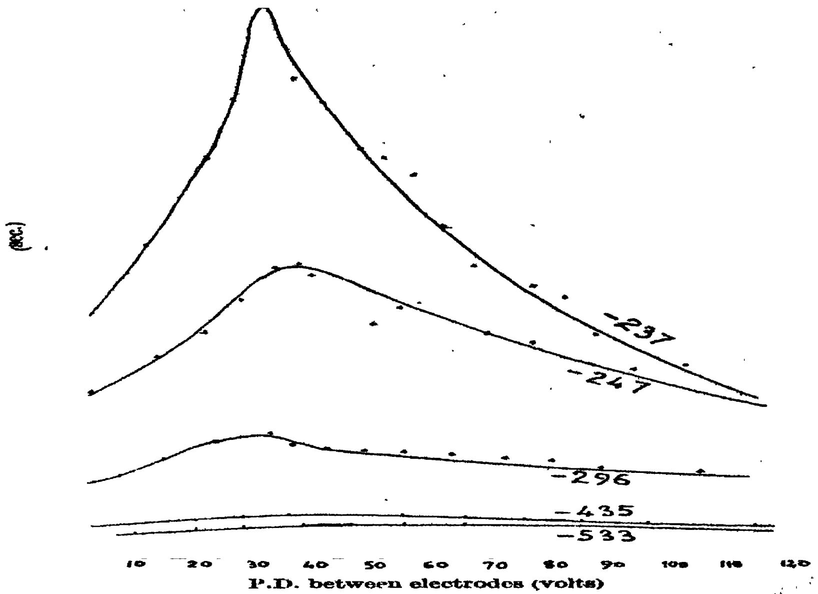

FIG. 2.—Graph showing the relationship between the applied potential difference and the period of flash for different values of the cathode potential.

the electrodes give different periods of flashing, but for a given voltage the period remains the same. The period of the flashes has a maximum value, but this value depends on the actual value of the negative potential on the cathode. There are no intermittent flashes when the plate is the cathode, and in fact the lamp refuses to light up until a certain high value of P.D. is reached.

Further experiments in this connexion were performed by employing an insulated high tension battery of 600 volts. Various negative potentials could thus be put on the rod-shaped electrode, keeping the outside of the lamp always earthed and the anode having throughout a negative potential of a numerically smaller denomination than that on the cathode. The results are shown in Fig. 2. The actual potential difference between the electrodes is marked on the abscissa and the period of flashing on the ordinate. The different curves are obtained by giving different negative voltages successively to the cathode (rod). For a P.D. of about 32 volts, each curve passes through a maximum, indicating that 32 volts is either a characteristic depending on the nature of the gas-filling or the geometrical (

of the electrodes. As the value of the negative potential increases, the P.D. across the electrodes remaining the same, the period of flashing diminishes. The following table will show this relationship. The maximum value of the period falls consistently with the increase in divergence of potential of the cathode from the earth.

Negative Potential of Rod (Volts).	Maximum Period of Flashing (Seconds).
237	9·04
247	4·78
296	2·03
435	0·70
483	0·61
533	0·57

It appears that the actual value of the potential of the cathode and the earthing of the outside of the bulb are important factors in the production of these low frequency low voltage discharges in neon lamps.

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Critical Potential in the Coagulation of Colloids by Electrolytes.

The accepted view of the coagulation of so-called hydrophobe colloids by electrolytes is that it is the result of a diminution of the potential of the electrical double layer. The potential is measured from the cataphoretic speed, u, by means of Helmholtz's equation, $u = D \cdot V/4\pi\eta$, where D is the dielectric constant, V the potential of the double layer, and η the viscosity coefficient. In 1926, S. G. Choudhury made observations in this laboratory which threw doubt on the above explanation of coagulation by electrolytes. Kruyt and Willigen (*Zeits. Phys. Chem.*, **130**, 170; 1927) have recently observed that in the coagulation of arsenious sulphide sol by potassium ferrocyanide, the cataphoretic speed is greater than that of the pure colloid up to the concentrations studied by them; their measurements, however, do not go up to the coagulating concentration. They attempt to get over the difficulty by assuming that the dielectric constant of the medium increases with the concentration of the electrolyte, so that though the cataphoretic speed is higher, the potential of the double layer is smaller than that of the pure sol. A number of observations show, however, that an impossibly large value of the dielectric constant must be assumed in order to reconcile the data with the above explanation. It also appears that the nature and even the manner of prepartion of the colloid have a great influence on the cataphoretic speed at the coagulating concentration of the electrolyte. We reproduce our data in the accompanying curves (Fig. 1).

Curves 1, 2, and 3 have been obtained from different dilutions of the same sol, and curves 4, 8, 7, and 9 from Freundlich's and Kruyt's observations. It will be seen that there are, broadly speaking, two types of curves, one (4, 5, and 8) showing a regular diminution with increasing concentration of the electrolyte, while the other curves (1, 2, 3, 6) show a much more complicated behaviour. Both types of curves refer to arsenious sulphide sol, but the method of preparation is different in the two cases. These observations definitely contradict the assumption that coagulation takes place at a critical potential, and consequently call for a theoretical treatment on an altogether different basis.

Attention may also be directed to a feature of curves 2 and 3, which show a drop in the cataphoretic speed during the progress of coagulation. This observation is interesting in connexion with the non-applicability of Smoluchowski's theory to 'slow' coagulation, which Majumdar attempted to explain on the assumption that the aggregation is reversible in slow coagulation but irreversible in 'quick' (*raschen*) coagulation. It may be remarked that Smoluchowski assumes irreversibility of aggregation. It seems the sharp drop in cataphoretic speed points to some irreversible change during aggregation.

J. N. Mukherjee.
S. P. Raichoudhuri.
University College of Science,
Calcutta, Oct. 10.

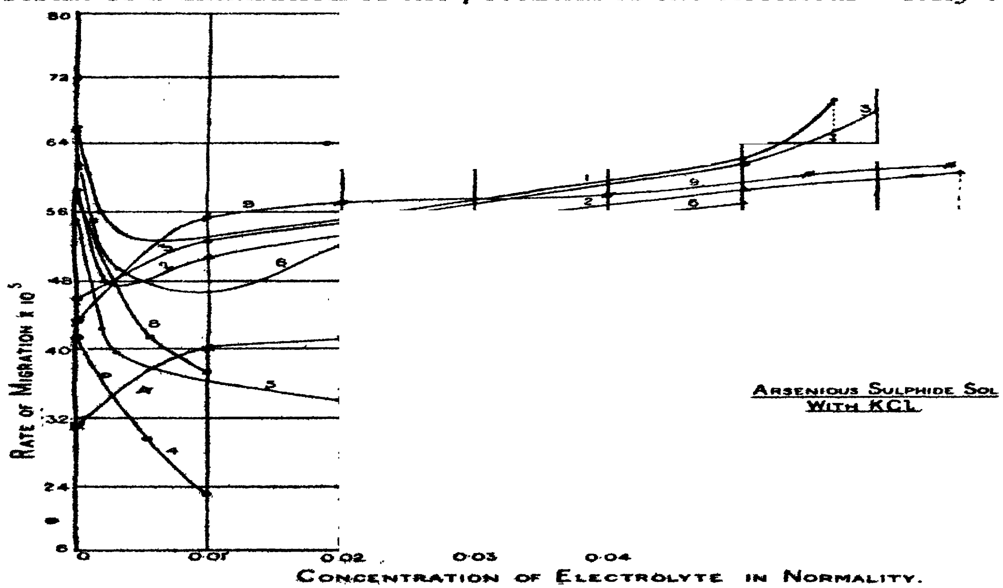

Fig. 1.

The Average Life Period of an Atom.

In the first Henry Herbert Wills Memorial Lecture, published in Nature of Nov. 3, Sir James Jeans has tentatively put forward the view that possibly no atom is eternal, but that they all spontaneously undergo transformations similar to that observed in the radioactive series. In fact, he goes rather further than this, for he suggests that even a hydrogen atom is finally itself converted entirely into radiation by the complete combination of the proton and electron composing it. It is to be observed that he assumes that this process

will not be affected by any temperature, or other external set of physical conditions, which can be possibly attained in the existing universe. If the process occurs at all accordingly, it should occur on the earth and hence be accessible to our direct experience.

As a matter of fact, the data quoted by Sir James Jeans himself *re* the observed energy flow from the earth's surface, enable us at once to place a minor limit to the average life of the existing terrestrial atoms. The heat flow from the earth's interior at present is about $1 \cdot 9 \times 10^{6}$ calorie per cm.^{2} per sec., or $2 \cdot 6 \times 10^{9}$ ergs per cm.^{2} per year. The total surface area of the earth $= 5 \cdot 1 \times 10^{18}$ cm.^{2}, hence the total loss of energy of the earth per year is $13 \cdot 3 \times 10^{27}$ ergs, equivalent to a loss of mass of $1 \cdot 5 \times 10^{7}$ grams. Now the mass of the earth itself is 6×10^{27} grams, hence if the earth is cooling, the average life of a terrestrial atom must be at least 4×10^{20} years, or about 10^{8} times the probable age of the existing universe.

It is to be observed that in the above calculation we have neglected the fact that a large portion of the energy loss is supplied by the known amount of radioactive elements present in the earth's crust. In fact, the surface materials are so rich that a layer about 13 km. thick would supply the whole loss, and it is only by assuming a rather arbitrary diminution of radioactivity with depth that we can ensure that the earth as a whole is cooling. If we accept Jeffreys' estimate that 87 per cent of the loss is due to the breakdown of the known radio-active elements, we can only attribute the remaining 13 per cent to the apparently stable elements, and this would lead to an average life for these elements of about 5×10^{21} years.

There is, of course, another possibility, that is, that the earth as a whole is not at present cooling, but that heat energy is steadily accumulating. This view is favoured by geological history, but the increase of energy production which it involves seems to be amply explained by the measured radio-activity of eclogites and other presumably deep-seated materials. It seems improbable, therefore, that there could be any large accumulation of heat energy due to the breakdown of ordinary elements at present taking place in the earth, and we are probably correct in concluding that the complete life of a terrestrial atom must be at least 10^{21} years. This age is so enormous compared with the estimated age of the universe, that we would seem to be justified in treating our terrestrial atoms as eternal.

J. H. J. POOLE.

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I QUITE agree with Dr. Poole. I had previously discussed the question he raises in a lecture, "Recent Developments of Cosmical Physics," published as a supplement to NATURE of Dec. 4, 1926; there is a similar discussion on p. 131 of my "Astronomy and Cosmogony": "Our terrestrial atoms have so little capacity for spontaneous transformation that they may properly be described as 'permanent.' . . . If the terrestrial elements underwent any appreciable transformation in periods comparable with 10^{17} years, the resulting generation of heat by the earth's mass would make the earth too hot for human habitation."

J. H. JEANS.

Radio Communication and Magnetic Disturbances.

LOOKING through the wireless data of Sir Douglas Mawson's Australasian Antarctic Expedition which has come into my hands through the untimely death of Dr. Chree, I have found a copy of the *Australian Monthly Weather Report*, vol. 4, No. 9. This contains Mr. F. J. Henderson's analysis of the working of the Macquarie Island station during 1914 and 1915 in the form of a statement of the dates on which the receipt of wireless signals was difficult or impossible, apparently excluding the days on which atmospherics were serious enough to cause the trouble. The stations with which Macquarie Island was generally in communication were Hobart, Wellington, and The Bluff.

In order to obtain confirmation of certain results from the first rough analysis of the logs of communication between Macquarie Island and the Antarctic base station, the international magnetic character numbers for each day of bad communication at Macquarie Island were tabulated from the lists printed in *Terrestrial Magnetism*. The mean character number for these days gave the surprisingly high figure of 1·1 for 1914, and 1·0 for 1915, compared with the mean values for all days of the months in question, namely, 0·55 for 1914 and 0·64 for 1915. This close relation between bad wireless communication and magnetic disturbance is the more surprising because the international character numbers are awarded mainly on the results from the more numerous magnetic observatories of the northern hemisphere. It would be interesting to compare these results with the magnetograms from the Christchurch Magnetic Observatory, which might be expected to show an even higher degree of correlation with wireless communication.

Communication appears to have been mainly carried out on wave-lengths less than 2000 metres, and the results refer to the era of crystal reception. In general, communication was not simultaneously bad from all three stations, but the days when communication was impossible from all of the three stations mentioned were, on the average, more disturbed magnetically than days when communication was less restricted.

The polar regions contain the auroral belts which are highly disturbed magnetically, and world-wide communication along great circle paths will often cross these belts. It becomes, therefore, a matter of practical interest that important magnetic storms are of worldwide occurrence, and that a disturbed day (or year) is likely to be followed immediately by another disturbed day (or year). It may be that close study will enable rules to be laid down as to the best means of roundabout communication by relay stations on bad days, analogous to the mariner's rule for avoiding the centre of a hurricane.

It may be mentioned that the apparent relation between bad wireless communication from New Zealand and neighbouring parts to Macquarie Island, and magnetic disturbance defined by the international character number, is closer than the relation between this character number and exceptional aurora observed at Macquarie Island.

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Nov. 27.

The Raman Effect in X-ray Scattering.

THAT a quantum of radiation can be absorbed in part by an atomic system, and the remaining part scattered by it giving rise to a radiation of increased wave-length, has been demonstrated by recent work on the scattering of light in material media. In his address on "A New Radiation" (*Ind. Jour. Phys.*, vol. 2, p. 398, Mar. 31, 1928) Raman pointed out that precisely similar effects should also be observable in the case of X-ray scattering. In other words, in addition to the Compton type, we should also have other modified X-radiations scattered by the atom, in which the scattering electrons alter their positions

in the atom, but remain bound to it. The frequencies of the radiations scattered by the atom would be

$$\nu' = \nu - \frac{E_1 - E_2}{}$$

where ν is the incident frequency, E_2 is the energy of the initial level and E_1 of the final level of the electron. When E_1 is positive, it may have an arbitrary value, and, as has been shown by Wentzel and others, the scattered radiation is of the Compton type, in which the change of wave-length depends on the direction of observation. On the other hand, when E_1 is negative, the electron remains bound to the atom, and we have a type of X-ray scattering completely analogous to that observed in the optical case. The frequency of the Raman type of X-ray scattering is independent of direction and is as sharply defined as that of the unmodified radiation.

Experiments to observe the new type of X-ray scattering here indicated have been in progress at Calcutta for some time. Meanwhile, results have been reported by Bergen Davis and Dana Mitchell (*Phys. Rev.*, vol. 32, p. 331; 1928) which may be regarded as a demonstration of its existence. Studying the scattered radiation from graphite excited by molybdenum $K\alpha_1$, they found three new lines the frequencies of which differed from that of the incident radiation by amounts corresponding to changes of energy level of the scattering electron by 279, 57, and 34 volts respectively. The first and the last may be identified with the transition of an electron from the K and L_1 levels respectively, to a level of very loose binding to the carbon atom. The radiation corresponding to a change of energy of 57 volts may be identified with the case in which both the L_1 electrons are shifted outwards. The latter supposition is not unreasonable in view of the well-known existence of double excitation in connexion with spark lines in the X-ray region of the spectrum.

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X-ray Studies on the Nitrides of Iron.

SINCE the two communications to NATURE of May 26 and Sept. 1, 1928, with the above title were written, I have done some more work on the nitrides with the highest nitrogen content attainable.

In the first communication it was mentioned that some of the lines in the photogram of a preparation with 11·3 per cent nitrogen (mean of three new analyses 11·23 per cent) were split, and the conclusion was drawn that this probably was due to the fact that the preparation consisted of two parts with different nitrogen content.

It has now been found that all preparations with maximum nitrogen content give exactly the same photograms, and it can be shown that these photograms are caused by a new phase ζ. In this phase the iron atoms form an orthorhombic lattice with the elementary dimensions $a = 2{\cdot}758$ A., $b = 4{\cdot}819$ A., and $c = 4{\cdot}419$ A. The co-ordinates 0 0 0, 1/2 1/2 0, 1/2 1/6 1/2, and 0 2/3 1/2 reproduce the observed intensities very well. These positions are quite analogous to those in an orthohexagonal cell of close-packed atoms, and the dimensions of this orthorhombic cell are also very similar to the dimensions of the orthohexagonal cell of the ϵ-phase at its highest limit of homogeneity, at about 11 per cent nitrogen. There exist consequently very close relations between the ϵ- and the ζ-phases, the nature of which still remains to be determined.

Owing to the evidently very limited homogeneity range of the ζ-phase, and the fact that its composition practically coincides with the formula Fe_2N, it is most probable that the ζ-phase is the nitride Fe_2N. The nitrogen atoms, therefore, probably occupy definite places in the lattice, though nothing in the photograms indicates this. This can, however, be explained by the small atomic number of the nitrogen.

Three Fe – N phases therefore evidently exist in the concentration range now investigated. The first, Fe_4N, has the cubic structure described before (also independently found by R. Brill; see *Z. f. Krist.*, 68, 379; 1928). The second is the ϵ-phase with a homogeneity range of about 8 to 11 per cent nitrogen and a hexagonal close-packed arrangement of the iron atoms. The third, ζ, is probably Fe_2N. Its iron atoms are arranged in an orthorhombic lattice, very similar to a hexagonal close-packing. It has not been possible to determine the positions of the nitrogen atoms in the two last phases.

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Action and Reaction in Rotary Motion.

A BICYCLE wheel, loaded at the rim, is placed upon an axle about four feet in length. This axle passes vertically through a hole in the centre of a rotating stool and is fixed rigidly to the stationary pedestal of the stool. A man standing upon the rotating stool can now set himself in rotation in one direction by turning the bicycle wheel in the opposite direction. A more striking demonstration can be given when the axle of the bicycle wheel is not fixed to the pedestal but rests upon the rotary part of the stool. In this case the man stands upon the stool grasping the axle of the bicycle wheel and holding it vertically in his left hand. With his right hand he sets the wheel in rotation (clockwise), and he necessarily rotates with the stool in the opposite sense (anti-clockwise). By applying the palm of his hand to the rim of the bicycle wheel, the man can stop his own rotation and that of the wheel at the same time. If a second man standing upon the floor stops the rotation of the man on the stool, the latter can again start himself in rotation by taking energy from the bicycle wheel. In a complete analysis of these rotations, friction in the bearings of the rotating parts must be taken into account.

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Plant Growth in a Cheddar Cave.

GOUGH'S Cave at Cheddar, Somerset, is illuminated by electric light in those parts which are shown to the public. Within a radius of about six feet from almost every electric bulb (of the ordinary gas-filled type) the rock or clay is covered with a growth of green plants. At some points there is only a film of *Protococcales*; at others the growth is more luxuriant and consists of mosses, liverworts, fern prothalli, and ferns. At a point about a quarter of a mile from the entrance of the cave there is growing a plant of the Hart's Tongue Fern (*Scolopendrium vulgare*) about eighteen inches in height.

We are informed that this growth of plants has only been noticed in the cave since the former 60 candle-power lamps were replaced by 120 candle power lamps about two years ago.

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Dec. 8.

The South Africa Meeting of the British Association, 1929.

THOSE members of the British Association who attended the meeting in South Africa in 1905 and propose to attend the Capetown-Johannesburg meeting in 1929, will find that much change has taken place in the intervening years. Nowhere will the change be more striking than in the places where the meeting will be held. The sites of the University of Capetown and of the University of the Witwatersrand (Johannesburg) may not vie with that of the University of Glasgow, where the meeting was last held, but their sites are nevertheless magnificent, and the accommodation available is sufficient to provide meeting-rooms for all the sections. Both cities, Capetown and Johannesburg, have town halls of large seating capacity for the larger evening meetings which form such a prominent feature of the British Association meetings.

The officers of the Association and the secretariats of the Sections will be housed at both centres in proximity to the meeting places, and it is hoped that this convenience will contribute to the success of the meeting.

The ocean voyage from Southampton to Capetown is one of the finest that can be taken for the length of time occupied: it is accomplished by the mail steamers of the Union-Castle Mail Steamship Co. in sixteen and a half days, the only port of call on the way being Madeira. The intermediate steamers of the same line, and the steamers of other lines, take a few days longer on the voyage.

The mail steamer leaving Southampton on July 5 will arrive at Capetown on the morning of Monday, July 22, and the inaugural meeting will be held in the City Hall on the evening of that day. At this meeting the assembly will be welcomed by the Mayor of Capetown and will be addressed by the president of the South African Association for the Advancement of Science, his Honour Mr. J. H. Hofmeyr, Administrator of the Transvaal Province. The retiring president, Sir William Bragg, will induct the president, Sir Thomas Holland, who, it is hoped, will deliver a short formal address.

Sessions of the sections will be held on the mornings of July 23–26. During the week, opportunity will be given to visitors to see the beauties of the Cape Peninsula with its unrivalled marine and mountain drives.

The first party, in two special trains, will leave Capetown on the morning of July 28; the trains will pass through the magnificent mountain scenery of the Hex River in daylight and will reach Kimberley on the following morning. The day will be spent in the Diamond City, where the visitors will be the guests of the De Beers Consolidated Mines, Ltd. Leaving Kimberley in the evening, the party will arrive in Johannesburg on the morning of July 30. The second party will leave Capetown on the morning of July 29 and, following the same route and programme, will arrive in Johannesburg on the morning of July 31.

The Johannesburg session will begin on July 31 and will be continued until Aug. 3. The presidential address will be delivered on the evening of July 31. During the week, visits to gold mines and to points of interest in the neighbourhood will be arranged.

It is proposed that some of the sectional presidential addresses shall be delivered at Capetown and that the remainder will be delivered during the second part of the session. Provisionally, it has been arranged that at Capetown the presidential addresses of Sections A (Mathematical and Physical Sciences), B (Chemistry), E (Geography), I (Physiology), J (Psychology), and L (Educational Science) will be delivered. The presidential addresses to be delivered at Johannesburg will be those of Sections D (Zoology), F (Economic Science and Statistics), G (Engineering), H (Anthropology), and K (Botany).

The fifteenth International Geological Congress is to be held in Pretoria on July 29–Aug. 7. Overseas members of the Congress will arrive in Capetown on July 15 and, after spending three days there, will proceed, by different routes and by easy stages, to Pretoria, which will be reached about July 28. Arrangements are being made for the second part of the session of Section C (Geology) to be held in Pretoria in association with the International Geological Congress; it is, however, definitely decided that the Section meetings are not to be merged in those of the International Congress, but that the two will take place simultaneously.

The Pan-African Agricultural and Veterinary Congress begins in Pretoria on Aug. 2, and it is intended that the second part of the session of Section M (Agriculture), at which the presidential address will be delivered, shall be held in Pretoria in conjunction with the Agricultural Congress. Pretoria can be reached from Johannesburg in about an hour either by road or by rail.

At the conclusion of the Johannesburg (and Pretoria) session, members may proceed direct to Capetown for the return voyage; leaving Johannesburg on the evening of Aug. 7, Southampton can be reached by mail steamer on Aug. 26. For those visitors who can afford the time, a wide choice of organised tours through South Africa and Rhodesia will be offered. The tours will permit visitors to see Rhodesia (Victoria Falls, Matopos, Zimbabwe Ruins), Eastern Transvaal (Sabi Game Reserve, White River Citrus Fields, Barberton Goldfields), Natal, Orange Free State, and Eastern Province (Cape). Arrangements will be made whereby members may embark at Lourenço Marques (Portuguese East Africa) or at Durban for the return voyage to Europe by the east coast of Africa route, or at Durban, Port Elizabeth, or Capetown for the return voyage by the west coast route.

As some of those tours will entail a considerable time being spent in the train, it may not be out of place to remark that, in spite of the narrow gauge of the South African railways, travelling is comfortable (apart from annoyance by dust), and the sleeping arrangements in the roomy coaches are satisfactory.

The meeting takes place during the South African winter. Capetown is in the climatic region of winter rains: for the period during which sessions will be held in Capetown the mean maximum temperature is 62° and the mean minimum is 48°, the average rainfall being about 2·5 inches per month. About ten hours by rail from Capetown the train will cross the line dividing the region of winter rains from that of summer rains. At Kimberley, Johannesburg, and Pretoria lower temperatures will be experienced than at Capetown, but clear skies and brilliant sunshine normally prevail during the season at which the meetings are to be held.

Local arrangements for the meeting are in the hands of the South African Association for the Advancement of Science and every endeavour is being made to ensure the success of the meeting.

Christmas Customs and their Origins.

OF the popular customs associated with Christmas, few have a Christian origin. The aim of the early Church was to distract its followers from the great festivals of the heathen, and consequently pagan elements were allowed to be incorporated as freely in the observance of Christmas as they were in the other major feasts of the Christian calendar. Here the pietistic sentiment of the Mediterranean peoples has tended to preserve the mystic element of paganism rather than the saturnalian. Hence the devotion to the Midnight Mass; and, as the cult of the Madonna enshrines the popular memory of the great pagan mother goddess, so the Cave of Zeus, of Adonis, and of Mithra survive in the cult of the Manger, in which both in the representations in the churches and in the popular shrines in the Italian streets, Mary, Joseph, and the animals kneel in adoration of the Child.[1] In Spain the Manger is set up even in private houses, where one or two rooms may be set aside for the purpose. In England the cult may be traced in the belief, once common in the west country, but not confined to that area, that at twelve o'clock on Christmas Eve the oxen kneel in their stalls. A connexion, with more than a flavour of paganism, may also be inferred in the divinatory custom of placing a cake on the head or horns of an ox in its stall on Christmas Eve, once practised in Herefordshire and other western counties and in the north, the prosperity of the coming year being foretold by the direction in which the cake fell or was shaken off. To the Manger cult may also be ascribed the 'vessel cup' of northern England, a box or framework, usually decorated with evergreens, containing a doll, or more often two dolls representing the Madonna and Child, which was carried from house to house by 'vessel cup' women or children. In the name 'vessel cup,' a corruption of 'wassail,' northern paganism combines with that of the south.

Among northern races, Christmas observances take on a different character from those of the Mediterranean area. Here Christmas coincided with the mid-winter feast of Yule, and popular custom, on the whole, has tended to emphasise the joyous nature rather than the solemnity of the observance. Harsher climatic conditions demanded a greater act of faith to believe in the return of the sun, and the rejoicing at the winter solstice when the sun god turned to his upward path was more strongly marked to a corresponding degree. In England, in particular, the festival, it was noted by early travellers, was kept up with greater zeal than in any other country. Here Christmas is Yule, and Mediterranean conceptions, though not absent, have relatively little influence.

The feast of Yule, though associated with certain of the northern deities, was in its origin a midwinter feast of sun worship, in which the characteristic features were rejoicing at the passing of the solstice, the sacrificial meal, and observances of a magical character to ensure the fertility of the coming year. Traces of all these survive in Christmas practice. There is also another aspect of the yule feast which has to be taken into account. It was a feast of the dead, and therefore a time of peril, when harm from their spirits must be averted. It was the time when the 'wild huntsman' rode with his hounds. Hence, even in Scotland, where the observance of Christmas is ignored, and at one time was made subject to penalty, divinatory and good luck practices were followed, similar to those of New Year. A dark man must be the first to enter the house in the morning, something should be brought into the house during the day, but nothing, especially fire, must be taken out or given away, and so forth. In Scandinavia everything in the house had to be left tidy and the tables laid for the Christmas meal before the family went to church, as the spirits of the dead came to inspect while they were away. Sometimes at the Christmas feast a special table was set aside for the spirits of the dead. Thus was prosperity ensured in the coming year.

In England a group of closely related customs connect Christmas with a feast of the dead. These are the yule log or yule clog, the yule candle, and the yule cake. The custom of the yule log was widespread—a huge block of wood was brought in with ceremony—sometimes it was provided by the overlord from the manorial woods—and was ceremonially lighted at a ritual hour on Christmas Eve and allowed to burn through the Christmas festivities. The sacred character of the fire is indicated by the injunction that the hands of the maid tending it must be clean; otherwise it will go out. A fragment of the log should be preserved for good luck and to light the next year's log, so that old and new might burn together. If the house of a neighbour caught fire, a piece thrown on the flames extinguished them. The yule candle was also lighted at a stated time on Christmas Eve. It should never be snuffed or put out, and no other

[1] A [illegible] Nationalist movement is now endeavouring to revive the Manger [illegible] displace the imported Christmas Tree, which is also [illegible] by the clergy.

candle should be lighted from it. Yule were often presented to their customers by chandlers. Sometimes when a family feast formed part of the observance, the candle stood on the table and was lighted at the beginning of the meal. The table must bear everything that was needed, as no one was allowed to rise until the meal was finished. The yule cake may be compared with the Soul Cake of All Hallows and served a similar purpose. In poorer families it was made with flour obtained by 'Thomasing' or 'Gooding' (see Calendar, Dec. 21), and usually bore a number of crossing lines. Everyone who entered the house at Christmas must partake of the cake, which was first cut at a regular and specified hour. Usually it was eaten with cheese. The crumbs were buried in the ground with seeds, thus ensuring fertility. At one time it would appear that the Church made an income by selling cakes for the purpose, appropriately marked with a cross.

The ceremonial fire of the yule log, the lighted candle, the solemn meal, and the ceremonial eating of the cake, are all practices such as are associated with the cult of the dead and of spirits, and by their observance secure prosperity and fertility. Nor is it unreasonable to attribute to the same origin the snap-dragon—the dish of rasins in blazing spirit—and the ignited brandy poured around the Christmas pudding. Even the now apparently trivial belief that the number of different makes of mince pies tasted ensures an equal number of years of prosperity or life, links up with the same idea.

The sacrificial meal among the northern nations, without losing its character of a solemn feast of the gods or the dead, grew into the convivial banquet of the overlord, his peers, and his retainers, when unrestricted hospitality prevailed, and even those who were not members of the household might share the convivial meal. The ceremonial passing of the wassail bowl in the manner of a loving cup, still marked the solemn nature of the repast.

Of the dishes, the traditional boar's head, still served in Queen's College Hall at Oxford on Christmas Day, was carried with all ceremony to the table as the midwinter sacrifice to the Scandinavian deity, Freyya. It was served with an orange, lemon, or an apple in its mouth, and was decked with rosemary or evergreens. It was therefore a fertility offering. So also the other traditional dishes, mince pies—a mixture of meat and spices—frumenty, of which the principal ingredient was corn, and the ceremonial goose, were offerings of the fruits of the earth to ensure their continuance and increase. In England, after the discovery of America, the place of the goose was often, and now is commonly, taken by the turkey.

It is not improbable that human sacrifices took place at Yule. This may be concluded from the action of the mummers, whose house-to-house visits, with those of the waits and carol-singers, were a regular feature of Christmas celebrations. Miracle and mystery plays were substituted by the Church, but died out, while the mummers lasted down to the nineteenth century, when their place was filled by the still surviving waits. In addition to the traditional dances, plays, such as the Cornish drama of St. George, were performed by the mummers. In these, one or both of the principal characters was killed and brought to life again—a symbol of the conflict of the seasons, the victory of light over darkness, or even, perhaps, of human sacrifice. The symbolism was even clearer in some of the sword dances of the north of England on Christmas Eve. Sometimes one of the performers carried straws in his mouth to represent the bristles of the hog to be sacrificed. In other dances one of the performers, either 'Bessy' or 'the Parson' interfered at the making of the 'knot' when the swords are interlaced into a geometrical figure, and was killed.

It is sometimes said that Christmas observances in England are derived from the Saturnalia, and to a limited degree and in respect of certain customs that may be. Such, for example, would be the election of a Lord of Misrule or an Abbot of Unreason, sometimes for the duration of the winter, or else at Christmas or at Twelfth Night, but this custom belonged rather to the Court and houses of the great nobles. In the popular observances the affinity is with Yule rather than with the Saturnalia, just as the Christmas games, bobbing for apples, scrambling for nuts, and hot cockles, hoodman blind, etc., were the traditional games of the earlier autumn and winter agricultural festivals, played on a more extensive scale.

As part of the Christmas feast, and as a magical vegetation charm, it was customary for the houses to be decorated with evergreens, especially holly, rosemary, laurel, bay, box, sometimes ivy, yew, and cypress. The last two, however, were not so common on account of their funerary uses. The early fathers discouraged the use of evergreens as a pagan custom, but it soon became a general practice in the Church. The mistletoe was used as a house decoration, but although Stukely mentions a solemn offering of mistletoe placed on the altar in York Cathedral at Christmas Eve, it does not generally appear to have been used in church decorations on account of its heathen associations. The custom of kissing under the mistletoe, when a berry should be taken from the bough by the man for each kiss obtained, may be a relic of the Saturnalia, but more probably of the licence of the older fertility festival. In the north of England, although the name mistletoe was used, on account of its scarcity the plant itself did not appear. The bough to which the name was given was usually box, on which had been fastened either oranges and apples, or sometimes hazel-nuts attached by the insertion of a box-leaf in a hole bored in one end of the nut. This rattled when the branch was shaken. In Lincolnshire eggs were fastened to the bough.

Sometimes, in the north of England, the name mistletoe was also applied not to a bough, but to a garland fashioned from flexible willow twigs to which sprigs of evergreen of one kind or another, little figures on elastic, apples and nuts and coloured tapers were attached. Sometimes a pole was erected and covered with evergreens, around which the

people danced. The garlands and the 'mistletoe' were in use so late as the middle of the last century.

The Christmas tree would appear to have been introduced into England from Germany at about the time of the Prince Consort, *i.e.* the middle of the last century. In Germany it was and continues to be an important institution. A description of the Christmas-tree ceremony there at the beginning of the last century says that it was a fir tree decorated with tapers and placed on a table. At its foot were presents which had been prepared for the various members of the family. It was placed in a room which was kept closed until a fixed hour, when the members of the household were admitted and the presents distributed. Even in Germany it does not appear to be an institution of any very great age. The earliest reference to it is in the seventeenth century, and it was only in the eighteenth century that it became general. From Germany it spread in the early nineteenth century to Scandinavia, where it became very popular, but it did not reach France, where it was introduced by German families, until the nineteenth century, after it had reached England.

The Christmas tree must be regarded as a development of the 'May tree' and as a vegetation charm to be related to the pole, the garland, and the 'mistletoe' customs of the north of England mentioned above, which the eggs—symbols of fertility—nuts and apples fastened to the bough, show to be of magical import. The connexion of the garlands and the pole covered with evergreens with the Mayday customs and the May tree is too obvious to need comment. The Christmas tree, therefore, although introduced late into England, as an emblem of fertility may be regarded as carrying on an earlier tradition.

In England it is customary for children to hang up one or both stockings on Christmas eve to receive the gifts of Father Christmas, of which apples, nuts, and oranges traditionally form part. On the Continent the place of the stocking is taken by one or both shoes. Father Christmas usually obtains access to the stockings or shoes by way of the chimney; and traditionally, though not invariably, the stockings are hung by the chimney-piece or the shoes placed on the hearth. This custom is a rite of the hearth analogous to the custom in German lore of placing shoes on the hearth to contain the payment or receive the gifts of the household elves who in favoured families performed the housework while the inmates slept.

The alternative name for Father Christmas of Santa Klaus points to the origin of the custom. It was the practice, as is recorded by Hospinian, to make gifts to the children on St. Nicholas Day in commemoration of certain acts of the saint. In Franconia boys fasted on the eve in order that the saint himself might come and fill their shoes with presents. In the performance of these good deeds he passed with his train from village to village throughout the night. The stocking appears in connexion with the saint's patronage of virgins. In various convents in France and Italy it was the custom of the inmates to hang a silk stocking at the door of the abbess, each containing a piece of paper or parchment on which was written what the owner desired of the saint, and the next the stockings were found filled with sweetmeats and other gifts.

The practice was not confined to children. At the Courts of certain of the Italian princes, the custom of Zopata—the custom of the shoes—was observed, by which on St. Nicholas Day favoured individuals found their shoes filled with gifts when they came to dress. Sometimes the saint himself appears. In Holland on St. Nicholas Eve he comes to the houses and holds an inquiry into the conduct of the past year, and after a gentle reproof for misdeeds and praise for good, disappears, the shoes of the children being found full of appropriate gifts the next morning. In Germ function is performed on Christmas E *Rupert*, who is usually said to be accompanied by a white horse. In a house-to-house visitation, good conduct is rewarded by a present from J us Christ, and bad by a rod for the parents, to be as the case requires.

Gifts at Christmas, however, are not confined to children, but are exchanged between adults. In so far as the evidence would point to their association with St. Nicholas, among northern peoples, excepting always Scotland, they have been transferred with the children's customs to Christmas. In southern Europe, more especially in France, the practice of making gifts now belongs to the New Year. In both cases the origin may thus be traced through St. Nicholas to the goodwill and rejoicing of the Saturnalia and mid-winter feast. In ultimate analysis, Christmas gifts and 'Christmas box' no doubt are one and the same; but in England they must be distinguished. They afford another example of the co-existence of a northern and a southern strain in Christmas observance. The custom of making gifts, usually of money, to those who may be in a socially inferior position, is of long standing.

The name 'Christmas box' is said to be derived from the custom of placing pence in a box for the Christmas masses for the poor; but its origin is even more remote. A whole group of customs point in this direction. By 'Gooding' and 'Thomasing,' provision was made for the Christmas ceremonial meal of the poorer members of the community. Mummers, waits, and carol singers were regaled with ale and food and received money gifts from the houses at which they called. Not only did the overlord sometimes provide the yule log, but those who were not members of his immediate household were at liberty to attend at least part of the Christmas meal or celebrations. Tradesmen contributed the yule candle or part of the articles necessary for the Christmas meal of their customers as 'Christmas boxes,' a custom which survived until recent years, though now perhaps only as the gift of an almanac or calendar. It would be a mistake to regard these as simply the manifestations of Christmas goodwill. The Christmas box was not always a

charity; often it was a fee. For in the house-to-house visitation of mummers, waits, and others, at other seasonal festivals as well as at Christmas, the gifts of money and kind made the donor free of the benefits accruing from the ceremony—good luck, fertility, and the like. The 'Christmas box,' in fact, was an expression of [illegible]munal character of the festival and a reaffirmation of the one-time solidarity of the social group when the well-being of the whole depended upon the due participation of every member in the prescribed ritual.

The 'Old-Fashioned Christmas.'

By Dr. C. E. P. Brooks.

WHEN the rain of Dec. 25, 1927, turned to heavy snow, the remark was probably made in thousands of homes in Great Britain that this was Christmas weather of the real old-fashioned sort. It is equally probable that any meteorologist present stated with conviction that the old-fashioned Christmas is a myth. Prof. W. J. Humphreys, of the U.S. Weather Bureau, is particularly severe on the similar belief current in America, assuring us that statistics prove it to have been "just the same as the new"; and nine out of ten meteorologists agree with his dictum. It is, however, quite possible to make out a plausible case in defence of the popular opinion.

Meteorological statistics show that recent winters in Great Britain have been abnormally warm. Comparable records are available for more than a century and a half in both London and Edinburgh, and show several interesting features. In London, after a well-marked maximum about 1780, there followed a pronounced minimum about 1815. The average temperature of the three winter months of 1814–15 was 32° F., this being the coldest winter of the whole series, but 1816 was little warmer. Temperature remained generally low until about 1848, after which a second series of warm winters occurred, with its crest in 1870. A second period of cold winters centred about 1890; from 1886 to 1895 inclusive, only one winter exceeded 40° F., while both 1890–91 and 1894–95 were exceptionally cold. During the present century the winters have become steadily warmer, and the average of the past ten years, 41·4° F., is the highest since records began. In Edinburgh the rise of winter temperature during the twentieth century has been even more marked than in London.

A similar result follows from a table included by Sir Richard Gregory in his paper on "British Climate in Historic Time" (*Geographical Teacher*, 1924), relating to the number of days of skating in Regent's Park, which totalled 236 during the ten winters from 1885 to 1895, compared with only 43 in the nine following winters. After 1904 the records unfortunately ceased, but one knows from personal experience that there has been little skating in London in the past twenty-five years.

An attempt has been made to discover whether there was any corresponding decrease in the number of days with snow, but the figures are difficult to collect, and such as were obtained were inconclusive. A tendency, generally in evidence, for the number to *increase* with the passage of time must be attributed to greater care in observing, rather than to a true increase. A specimen study of the eight days centred round Christmas showed for the twelve years 1870 to 1881 in London exactly the same average as for the 30 years 1886 to 1915; while in Aberdeen the twelve years were decidedly less snowy than the general average. On the other hand, a count of the very snowy and of the almost snowless winters in the British Isles, as described in Mr. L. C. W. Bonacina's paper on "Snowfall in the British Isles" in "British Rainfall" for 1927, gave for the 25 years 1875–76 to 1899–1900, 12 very snowy and 6 almost snowless winters; while the subsequent 25 years gave 7 very snowy and 9 almost snowless, an apparent decrease in snowfall which accords better with the change of temperature.

Although, on the whole, the popular belief thus seems to be justified by statistics, there are several considerations which suggest that the 'old-fashioned winter' was not the winter of a generation ago. The variations quoted above, with the possible exception of the cold spell round 1815, were comparatively small fluctuations, scarcely large enough to impress themselves on slow-moving tradition. Moreover, the belief occasionally crops up in the written records of an earlier day. Mr. Bonacina points out, in the article referred to, that two observers described the snowfalls of December 1878 as resembling those of a former generation, and Dr. Glasspoole quoted in the *Meteorological Magazine* for April 1927 a reference, written in 1853, to "one of the old-fashioned winters, snow and frost." No doubt there are still earlier references, but I do not think that Pepys uses the term anywhere in his diary, as would have been likely had the belief been current in his day.

There seems to have been a real change of climate about 1750. Before that date there was a prolonged period, approaching a century, of abnormally dry weather in England. At the same time, weather in Norway was stormy and snowy; this and other facts suggest that our droughts were of the 'anticyclonic' type, which would be accompanied by generally cold weather in winter. This was the time of the great 'frost fairs' on the Thames, notably 1683–84, 1715–16, and 1739–40, events which were likely to impress the memory of Londoners in a way which mere weather could not do, and which were kept in mind by the numerous 'relics,' such as engravings and ballads from printing presses set up on the frozen river. If the 'old-fashioned winter' ever had a real existence, no series of years is more likely to have given birth to the tradition.

An alternative possibility remains to be considered; namely, that the belief results from

inaccurate mental processes. Three theories may be mentioned. The first is that the change of the calendar was responsible. In 1752 eleven days were added to the date, so that in 1751 Christmas Day fell on Jan. 5, new style, that is, almost exactly at the coldest time of the year. The long record at Greenwich shows, however, that the difference between the mean temperatures of the end of December and of the beginning of January is inappreciable. Moreover, the 'old-fashioned Christmas' is practically interchangeable with the 'old-fashioned winter.' Secondly, Mr. M. T. Spence, in the *Meteorological Magazine* for January 1927, points out that long spells of cold weather occur less frequently than long spells of mild weather in winter, so that by the time a cold spell arrives, the preceding one has passed into the hazy 'good old days.' His figures, however, refer only to spells which are statistically cold or mild, and the popular idea of the weather is often at variance with the statistical. A more plausible theory is that the belief is upheld by the memories of immigrants into London from the colder and more snowy north. A difficulty is that the belief is not confined to London, but is deeply rooted in many rural districts where the amount of immigration is very small.

None of these ingenious theories satisfies, but after all, is such ingenuity necessary? A change in our sense of proportion as we grow older would seem sufficient, for a few frolics in the snow when we were young would colour all our memories of winter. The change may not be in the weather, but in ourselves.

I would suggest, therefore, that the belief in the 'old-fashioned Christmas' may have originated in a series of severe winters in the late seventeenth and early eighteenth centuries, but that since then its vitality has been purely subjective, so that it now refers not to any definite period of time, but to the childhood of the speaker.

The Broadcasting of Seismological Reports.

FROM the records of a single well-equipped observatory the position of the epicentre of a large earthquake at a great distance can normally be determined with considerable accuracy. Closer estimates can be made, however, when the records from several stations are available, and especially when the stations are well distributed over the world. A system of exchange of seismological information by cable was inaugurated several years ago by the British Association. By the use of information received from stations in India, Australia, and America, Prof. H. H. Turner, chairman of the British Association Seismological Committee, has been able to determine the details which he has communicated regularly to the Press.

For the circulation of meteorological data, the submarine cable has been almost superseded by wireless telegraphy, and it is a natural development to use the latter medium for inter-communication of seismological information. The first step was taken by France. Since 1921 the readings of seismographs at Strasbourg have been broadcast regularly from the Eiffel Tower. The information is added to synoptic weather messages by the French Meteorological Office. The seismological code was given an international standing by publication in the report of the Rome meeting (1922) of the Seismological Section of the International Geodetic and Geophysical Union. The code is used by the Egyptian Meteorological Service for reports from Helwan. Since the beginning of 1927, seismological reports from Kew Observatory have been broadcast by the Air Ministry with the midday synoptic weather report which is sent out from Kidbrooke at 14 h. 0 m. G.M.T. Arrangements have been made by the Air Ministry for the transmission to London of seismological reports from Bombay. These reports also are broadcast from Kidbrooke.

In America, co-operation amongst the various bodies interested in seismology is well organised. Information is collected from the United States and Canada by the United States Coast and Geodetic Survey, by the Jesuit Seismological Association, and by Science Service, the well-known news agency. At the request of the Meteorological Office, London, it has now been arranged that from Jan. 1, 1929, seismological reports will be transmitted regularly from Arlington with the meteorological synoptic message which is sent out at 4 h. 0 m. G.M.T. This service is made possible by the co-operation of the United States Coast and Geodetic Survey, the United States Weather Bureau, and the United States Navy. The meteorological message from America is re-broadcast from the Eiffel Tower at 6 h. 20 m. G.M.T., and the seismological information will be included in the re-issue. The international or Strasbourg code will be used for this service. Details regarding the code, wave-lengths, etc., will be supplied by the Superintendent, Kew Observatory, Richmond, Surrey, on request.

The data will refer to two stations which will be selected on each occasion by the Coast and Geodetic Survey. The stations will be chosen from those for which the phases of the earthquake are well determined. Stations not too far from the epicentre and pairs giving a good angle of intersection will be selected.

The list of possible stations includes not only nine in the United States (Berkeley, Chicago, Cincinnati, Fordham, Georgetown, Harvard, St. Louis, Sitka, and Tucson), but also two in Canada (Ottawa and Victoria), one in the West Indies (San Juan), and four in or beyond the Pacific (Apia, Honolulu, Manila, and Wellington).

The new service will be much appreciated by European seismologists. The elasticity of the system by which the most valuable data are selected for transmission is noteworthy. In some cases trustworthy estimates of the positions of the epicentres of earthquakes will be available at once instead of after a delay of several weeks.

Obituary.

DR. J. McA. HENDERSON.

NEWS has been received by cable of the death of John McAskill Henderson, at Nairobi, in Kenya Colony, East Africa, where he was carrying out research on deficiency diseases on the African native. Dr. Henderson was a graduate of the University of Edinburgh, where in addition to having a distinguished academic career he was president of both the Students' Representative Council and the Students' Union.

In 1923 Dr. Henderson joined the staff of the Physiology Department of the Rowett Research Institute in Aberdeen. His chief work in Aberdeen was in connexion with the effects of ultra-violet irradiation on mineral metabolism in animals. The results of his investigation on this aspect of nutrition made a permanent contribution to our knowledge of the subject.

In 1926, Dr. Henderson was sent to East Africa with a group of other workers from the Rowett Institute to carry out an investigation on deficiency diseases in farm animals and African natives. The reports on this work which have been sent home show that he has opened up a field of investigation of exceptional interest. The data accumulated seem to throw new light on some of the problems of disease in the African native. This investigation, which was carried out in co-operation with Dr. Gilks, Principal Medical Officer of Kenya, and his staff, was done under the general supervision of a subcommittee of the Civil Research Committee, consisting of Major Walter Elliot, M.P., Sir Frederick Gowland Hopkins, Sir Walter Fletcher, Prof. E. P. Cathcart, Dr. A. T. Stanton of the Colonial Office, and the Director of the Rowett Institute. All the data collected by the late Dr. Henderson and his colleagues are available, but the lack of Dr. Henderson's help in their interpretation will be a serious loss to the investigation.

Dr. Henderson was a man of wide culture, who was much beloved by his colleagues. Although only thirty-three years of age he had already done brilliant research work, and had undoubtedly a most distinguished future as a physiologist. His death is an irreparable loss not only to the Institute to which he belonged, but also to the wider field of scientific research in which he was engaged.

J. B. O.

DR. MAX MARGOSCHES, professor of chemical technology at the German Technische Hochschule in Brünn, died on Sept. 27, after an operation, in his fifty-second year. We are indebted to the *Chemiker-Zeitung* for the following details of his life and work. Born at Jassy, in Rumania, Margosches studied at the Technische Hochschule in Vienna and, after graduation there, was appointed assistant to Prof. Donath at the Technische Hochschule in Brünn. In 1906 he became lecturer on the chemical technology of mineral oils, fats, and asphalts. He was appointed extra-ordinary professor in 1913, and in 1918 he succeeded to the chair of chemical technology. In conjunction with Donath he carried out numerous investigations on coal, asphalt, and tar. Margosches' success in this field led to his appointment by the Austrian Ministry of Commerce as a delegate to the International Petroleum Congress, where he prepared a comprehensive report on the ubject of asphalts, and he was elected a member of ne International Petroleum Commission. In 1907 e began the publication of a comprehensive work on hemical analysis, which has had a wide circulation mong analysts. The researches of Margosches and is pupils in the field of chemical technology, and articularly of oils and fats, led to the publication f a large number of scientific papers, many of which dealt with iodometric methods of analysis and the applicability of Kjeldahl's method of stimating nitrogen to the analysis of nitro-groups n organic compounds.

MR. DOUGLAS J. P. BERRIDGE, who died on Nov. 11 after an operation in London, spent nearly he whole of his life as senior science master at Malvern College. The eldest son of Mr. Thomas Berridge, solicitor, of Leicester, he went up to Vadham College, Oxford, and took honours in atural science in 1892. He was for a short time master at Dulwich, before his appointment to Malvern in 1893. At that time science was almost nknown as a school subject, and Berridge was one f the pioneers of science teaching. The proposal o found a Science Masters' Association originated 1 1900, when a letter was sent out from Eton to he science masters in 57 schools. The result was he Association of Public School Science Masters, hich later became the Science Masters' Association. Berridge was one of the original members, nd in 1907 was appointed secretary, holding the ost for the maximum period of four years. Ie served for several years as secretary of the ection of Educational Science of the British Association, and also as recorder of the Section. To he end of his life, and in spite of serious ill-health, Berridge remained an indefatigable worker, always anting to undertake more than his fair share of ommon duties in school or in committees. Enhusiastic and often inspiring as a teacher, he included F. W. Aston among his pupils. As a housemaster at Malvern he quickly won the devotion of is boys, many generations of whom will remember is example with affection. Increasing ill-health nally compelled his retirement in April 1927.

WE regret to announce the following deaths:

Mr. James Edwards, curator and secretary to the te Mr. H. J. Elwes, with whom he was associated in e preparation of several monographs on the lesser nown butterflies, and himself an authority on British eetles and Homoptera, on Oct. 13, aged seventy-two ears.

Dr. Frank C. Wagner, president of the Rose Polychnic Institute since 1923, known for his work on ynamo design and engine testing, on Nov. 21, aged xty-four years.

News and Views.

THE continued illness, and consequent physical weakness, of his Majesty the King fill the minds of his devoted people with anxiety and their hearts with deep sympathy for all the members of the royal family. During the past month the thoughts of millions of citizens at home and overseas have been turned towards the bed of sickness at Buckingham Palace, and every bulletin recording the King's condition has been eagerly awaited. It is not surprising that the very trying time through which his Majesty has been passing should have led to weakness and almost to exhaustion, but by using every resource at the disposal of modern medical science, the royal physicians have been able to maintain his strength sufficiently to justify the hope that the troublesome malady and its effects will be completely overcome, though progress towards perfect health may be slow. What we are anxiously watching is veritably a fight against disease with weapons provided by the best existing knowledge of bacteriology, radiology and electro-therapy, aseptic surgery and neurology. We cannot entertain any other thought than that through these applications of science and medical skill his Majesty will be preserved for many years yet to receive the homage of his faithful people.

SIR WILLIAM BOYD DAWKINS, distinguished in the departments of geology, archæology, and anthropology, celebrates the ninetieth anniversary of his birth on Wednesday next, having been born on Dec. 26, 1838. We offer very hearty congratulations, in which we are sure all scientific workers will join, to this veteran of the old-time 'joyous band' of geologists. Sir William was elected a fellow of the Royal Society sixty-one years ago; his fellowship of the Geological Society is, however, of longer period—sixty-seven years, though that is exceeded in the case of Mr. Ernest Noel, who has been on the roll actually seventy-nine years, and whose age is ninety-seven. Son of a clergyman, Sir William Boyd Dawkins was born at Buttington Vicarage, near Welshpool, Montgomeryshire. Educated at Rossall, he graduated at Jesus College, Oxford, of which college he is an honorary fellow. Evincing a strong bent for geology, he obtained a post on the Geological Survey of Great Britain in 1862, remaining until 1869, when he became curator of the Manchester (Owens College) Museum, his connexion in this capacity covering a long series of years; it would be difficult indeed fully to appraise the consequent high value of his services. He is still personally concerned in the development of the institution. Sir William took up in 1874, and long held, the chair of geology and palæontology in Owens College (afterwards Victoria University). An original member (1882) of the scientific committee discussing the Channel Tunnel project, Sir William was entrusted with the geological survey of the English and French coasts. Stimulated by the researches of Prestwich, he engaged in considerations referring to the existence of coal deposits in Kent. Thirty-eight years back, in a communication to NATURE of Mar. 6, 1890, entitled, "The Discovery of Coal near Dover," the story of the enterprise was recited in illustration of the progress of a scientific idea passing through various phases. The south-eastern coalfield is now "clearly defined, and ranks among the assets of the nation" (Dawkins, 1918).

A LONG and varied list of papers recorded in the Royal Society's "Catalogue of Scientific Papers" stands to the credit of Sir William Boyd Dawkins. Chief in importance may be mentioned his series of monographs on "The British Pleistocene Mammalia," issued by the Palæontographical Society (1866–87). Wild animals, he remarks, are of equal interest to the geologist, the archæologist, and the historian; for they afford to the first a means of classifying the deposits with which he has to deal, while in archæology and history they bear a direct relation to the numbers and civilisation of the human dwellers in the same region. Besides the foregoing, his published works include two fascinating books, "Cave-Hunting" (1874) and "Early Man in Britain" (1880). The former treated of the formation of caves and of the light thrown by their contents on the sojourn of man in Europe, and on the changes in climate and geography. Of similar significance was his co-operation in the exploration of the hyæna den of Wookey Hole, near Wells. Sir William is Hon. D.Sc. (Oxon), and he has received from the Geological Society the Lyell and Prestwich medals. He was president of Sectio C (Geology) at the British Association's meeting at Bath in 1888.

THE centenary of the death of William Hyde Wollaston—a contemporary of Davy and Dalton—falls on Dec. 22. Wollaston was born in 1766 at East Dereham, Norfolk, the birthplace also of George Borrow. Although endowed with the cautious judgment of a true natural philosopher, and the manipulative skill of a wizard, he yet just missed that lofty eminence in the world of science which some of his associates attained. His interests lay mainly in the infinitely little; in a microcosm of his own making. After being educated at Charterhouse and Cambridge Wollaston set up in practice as a doctor at Bury St. Edmunds. However, on account of his shyness and sympathy with physical suffering, he realised his unfitness for a medical practitioner. Luckily he came into a comfortable fortune, and was able to abandon medicine and devote his talents to applied science, when still as a young man he was trying to establish himself as a physician in the metropolis. In 1793 he was elected a fellow of the Royal Society—his father at one time was on its council—and throughout the rest of his life he worthily upheld the honour of that distinguished body, as a constant contributor to its publications, as a secretary, and in 1820 as interim president; he having been elected to succeed Sir Joseph Banks, but knowing Davy's ambition, he vacated the chair a few months later.

WOLLASTON'S remarkable acuteness of vision was often a topic of conversation among his intimate friends. On horseback he could detect small plants that others

could only see, when dismounted and close to the hedgerows. He discovered several dark lines in the solar spectrum with his naked eyes. This attentiveness to minute things is exemplified in the construction of his well-known gossamer threads of platinum wire, and in the making of a voltaic cell in a tailor's thimble, powerful enough to raise those fine strands to incandescence. Sometimes at house parties he surreptitiously tested the range of audibility of the guests by blowing a shrill pocket whistle. His discovery of the rare metals palladium and rhodium was a direct result of superfine chemical analysis of the discarded remnants of platina residues. So extensive and generally so infallible was his knowledge of scientific matters that he was familiarly called the 'Pope.' To many of his inventions and discoveries Wollaston gave a practical and marketable form, and his periscopic spectacles, camera lucida, and reflecting goniometer found a ready sale; while his rediscovery of the art of cutting diamonds and of rendering platinum malleable greatly increased his income. He bequeathed funds and presents to the Royal Society, the Royal Astronomical Society, and the Geological Society, the Wollaston medal of which is named after him.

ON the same day that Wollaston died, Robert Blair, the first professor of practical astronomy in the University of Edinburgh, passed away at Westloch, Berwickshire, having held his post since 1785. Blair had been a naval surgeon, and was present at the action of April 12, 1782, when Rodney beat the Comte de Grasse in the West Indies, and he attended Capt. Lord Robert Manners, who was mortally wounded. The noble family to which Manners belonged, in gratitude to Blair, solicited the Crown to found a chair for him, and thus Blair became a professor at Edinburgh. The post, however, was a sinecure, with a salary of £120. The writer Doran, some years ago, said: "If Blair was not a practical astronomer he was an experimental philosopher of great repute, and his experiments and observations on the refrangibility of light excited considerable interest in his own day, and may be read with profit even now, when philosophers and experiments have equally increased." Unfortunately, few details are known of Blair's life.

AT a recent meeting of the Council of the National Museum of Wales, a letter was received from H.M. Treasury intimating that the Government is prepared to make grants from the National Exchequer, amounting to £50,000, towards the cost of erecting the second section of the National Museum of Wales. This section will include the East Gallery and the lecture theatre, and will provide six additional exhibition rooms. The total cost of this further building is estimated to be £150,000. Of this sum about £50,000 is in hand, and the Treasury grant is made on the condition that the further £50,000 required will be d locally. The Government has been induced to this special grant with the view of affording to the exceptional amount of unemployment prevalent in the South Wales area, and on the understanding that the contracts will be so placed as to employ South Wales labour, directly or indirectly, to the utmost possible extent. In spite of the acute depression in the South Wales area, it is expected that the sum required will be subscribed in a short time and so enable the offer of the Government to be redeemed. Plans, specifications, and bills of quantities for part of the work being already prepared, the Council is in a position to accept tenders for part of the contemplated building at once, and it is hoped that work will begin early in the New Year. The completion of the new wing will take about three years, but when it is erected Wales will have in its National Museum one of the finest and most up-to-date museum buildings in the world.

IN engineering industry there are unfortunately some who have initiated inventions which have proved of great commercial value, and yet have reaped little or nothing from their invention. A few take this in a philosophic spirit and are not embittered by seeing others being honoured for having taken some slight part in the development of their ideas. Occasionally we find one who takes a pride in his obscurity. He knows that he deserves well of his fellow-men. He is not blind to his own merits, and he resents being patronised by governments, societies, or individuals who know little of his work. Outsiders regard him as a hermit, or possibly a misanthrope. Luckily, however, he generally has a few friends whose appreciation he values. Such a one was Oliver Heaviside, whose life history as a pioneer has been well written by Mr. Rollo Appleyard in *Electrical Communication* for October. His invention of the distortionless circuit in telephony and the great commercial developments to which this gave rise are now well known. Many of his discoveries, however, are not so well known, the reason being partly due to a stubborn clinging to his own methods and symbols, which puts difficulties in the way of everyone who has not studied his writings closely. Some of his friends—Heinrich Hertz, for example—were well aware of this. We notice that in a letter written to him by Hertz from Bonn in 1890, he is told that it is a false pride which prevents him from explaining to others more fully how his results are arrived at. It is ancient wisdom "that the many will expect you to come to them and not come up to you, be your merits ever so great." Thus it was not for lack of good worldly advice that Heaviside preferred to travel by the difficult path he chose.

AT a general meeting of the Society for the Preservation of the Fauna of the Empire which was held in the lecture hall of the Zoological Society, Regent's Park, on Dec. 10, Dr. J. M. Derscheid, of the International Informatory Office for the Protection of Nature, Brussels, introduced the late Mr. Carl Akeley's film taken in the Kivu Parc National Albert, Belgian Congo, which has never been exhibited in public. This film shows interesting scenes in the life of the mountain gorilla, and a wonderful presentment of the live volcanoes and lava lakes of the Kivu area. The Belgian Ambassador, H. E. Baron de Cartier de Marchienne, afterwards gave an address on the Kivu

national park, and expressed the hope that the British administration of the adjoining area of Uganda would declare the gorilla country on its side of the border also a sanctuary for the animals. Mr. J. Smit, High Commissioner for the Union of South Africa, described what is being done in respect of declaring game reserves and national parks in South Africa. Many farmers there are now sparing baboons, for they do so much good by destroying harmful insects among the crops, that they much more than make up thereby for the grain that they consume themselves. The meeting passed a resolution that "the Society has heard with concern and regret that an English party has left for Africa on an aeroplane alleged to be equipped for the pursuit of wild animals from the air."

THE twenty-fifth anniversary of the first controlled flight in a power-driven aeroplane, made at Kitty Hawk, North Carolina, on Dec. 17, 1903, by the Wright brothers, was celebrated at a dinner held at the Science Museum, South Kensington, on Monday last. The dinner was held under the auspices of the Royal Aeronautical Society and, most appropriately, in the gallery of the Museum where the original Wright machine hangs. Mr. Griffith Brewer, who was the first Englishman to fly with the Wright brothers and has been closely associated with them, gave a short address on their work, in the course of which he said that the Wrights, having considered fully the work of their predecessors in attempts at human flight, decided that the main problem was equilibrium rather than the application of power to wings. They built a glider, which was balanced by changing the angle of the wing tips. A long series of measurements of the lift and drag of the machine were made, in the light of which other gliders were built and tested, a wind tunnel having been constructed meanwhile in order to examine the effects of wind pressure on surfaces at various angles. Finally, the first power-driven machine was designed and built, even to the engine and propellers, and successful flight was accomplished on Dec. 17, 1903. Four flights were made before a gust of wind tipped the machine over and wrecked it, but it has recently been restored by Mr. Orville Wright, and now hangs in the Science Museum. The anniversary was celebrated at Kitty Hawk in the presence of Mr. Orville Wright and representatives of the U.S. Government and various aeronautical organisations, by the unveiling of a granite boulder bearing a memorial tablet.

As honorary president of the Edinburgh University Forestry Society, Col. F. R. S. Balfour, of Dawyck, delivered his presidential address to the Society at the University on Dec. 7. His subject was "The Trees of the North Pacific Coast of America," illustrated by a fine series of slides from photographs taken by himself. Col. Balfour pointed out that the arborescent species on the west and east of the main Continental Divide of the Rockies differ entirely; owing to a similarity of climate many of the conifers on the west do well in Great Britain, whereas the reverse is the case with the many fine hardwoods—oaks, hickories, maples, etc.—growing to the east. Many slides were shown depicting, in their natural surroundings, exotics now well known in Great Britain, such as Douglas, hemlock, several silver firs, spruces, sequoias, and pines. Col. Balfour recalled the fact that the first knowledge in Europe of these species was due to Archibald Menzies, who was doctor on board of Vancouver's ship the *Discovery* and collected species in 1792. Thirty years later David Douglas was sent out by the Royal Horticultural Society and was the first to send home seed of Pacific coast conifers.

IN speaking to the toast of "Forestry" at the Edinburgh University Forestry Society's annual dinner on Dec. 7, Prof. E. P. Stebbing dealt with the possibilities which the Benmore estate in Argyllshire, presented by Mr. Harry Younger to Government in 1925, offers as a practical training centre and research station for forestry educational centres in Great Britain. Including two neighbouring estates purchased by the Forestry Commission, the area extends to some 8000 acres, with a number of plantations of different types, forest nurseries, an arboretum, and a mansion-house capable of providing quarters and other facilities for visiting students. It is also intended to have a botanical garden at the centre, which is receiving consideration from the professors of botany of Edinburgh and Glasgow. After pointing out that many Continental European forestry schools have areas of woods attached to them for educational and research purposes, Prof. Stebbing said that it might be possible for the appropriate Government department and the heads of university schools interested to work together to develop the possibilities of Benmore. In speaking to later toasts, both Prof. Wright Smith and Dr. J. D. Sutherland, of the Forestry Commission, referred to Benmore. Prof. Wright Smith said they could not have fallen upon a happier spot in the Western Highlands, and the prospects are peculiarly attractive. There are many problems, and it is early yet to say on what lines they will develop. Dr. Sutherland said that it is the wish of the Forestry Commission that Benmore shall be made use of in every possible way for forestry and botany, and he is satisfied that those responsible will call in and be guided by those who can tender valuable advice.

THE second International Conference on Bituminous Coal began at Pittsburgh on Nov. 17. Dr. T. S. Baker, in opening it, visualised a time when the pipe for liquid and gaseous fuel and the cable for power, all obtained from coal, would displace the coal truck. He urged the endowment of research to develop coal, the "most useful raw material with which man is endowed." Many nations were represented and some interesting announcements were made. Thus Dr. C. Krauch described the results obtained by the I.G. on the hydrogenation of solid fuel. Germany has become independent of many imported raw materials—fuel oils, lubricants, fats—edible and otherwise. Thus at Leuna the annual output of synthetic motor spirit will by the end of 1929 have reached 250,000 tons. Hydrogenation has proved to be a means of

desulphurising mineral oil, and by arrangement with the Standard Oil Co., this is to be introduced into American refinery practice. At some future date such a process might be of decisive importance in refining oil from English shales rich in sulphur. Dr. Krauch advances a new theory that petroleum results from the hydrogenation of vegetable remains.

M. G. CLAUDE gave an account at the Second International Conference on Bituminous Coal of his proposals for generating power by utilising the difference of temperatures found at the surface and the sea bottom. He has constructed a model installation to show how water vapour at the surface can be expanded through a turbine and then condensed to a vacuum at the low temperature of the sea floor. Such an invention would seem to lack urgency until the world's coal resources near depletion. A. T. Stuart of Toronto returned to the advocacy of production of hydrogen and oxygen by the electrolysis of water, by off-peak current of hydro-electric stations. The hydrogen could be made available for chemical synthesis and the oxygen for other purposes, among others for the gasification of fuel. He visualises a condition where the oxygen might be had almost cost free. This suggestion is interesting, because the use of oxygen in gas-making has been repeatedly considered, but the price of oxygen has hitherto been a stumbling-block.

THE Laboratory of the Division of Animal Nutrition, the first building to be completed by the Commonwealth Council for Scientific and Industrial Research, was officially opened in the grounds of the University of Adelaide, by the Prime Minister of Australia, on Oct. 22. In this laboratory there will be carried out, under the direction of Prof. T. Brailsford Robertson, all the fundamental biochemical work upon which he proposes to base his studies of nutrition of stock, and particularly of sheep. The cost of the laboratory is approximately £14,000, and it is of two stories. On the ground floor there are a general office, recording and computing department, drawing office, dark room, centrifuge room, office and laboratory of the Chief of the Division, three laboratories for chemists, and caretaker's and store rooms. The first floor is divided into two similar portions, each containing an office for a technician and preparation room, an animal room (for mice on one side and rats on the other), kitchen, sterilising and washing rooms, and food bins. In addition to the work going on in this building, field work on sheep is in progress at the Waite Institute and also at four field stations which have been established, one some 200 miles north of Port Augusta (South Australia), another near Beaufort (Victoria), a third at Moree (New South Wales), and quite recently a fourth at Springsure (Central Queensland).

AMERICAN scientific institutions have the knack of making their annual reports interesting to a wide field of readers. This is mainly because they are engaged in a variety of exploration work and do not hesitate to describe in vivid language the adventures of their explorers in their collecting grounds, instead of simply cataloguing the trophies of the trip. The *Year Book of the Academy of Natural Sciences in Philadelphia* for 1927 keeps up the tradition. Wharton Huber describes his observations on the habits of the birds in the Bear River region of the Great Salt Lake, where he made good use of the 'alkali poisoning' which has destroyed thousands of ducks there, by collecting from the dead and dying complete plumage series of six species of ducks which breed in the area. Clement B. Newbold clearly enjoyed his experiences in hunting Stone's sheep and the mountain goat of British Columbia for two museum life-groups. It is interesting to note that the progress of the exhibits in the museum is entirely due to the generosity of members and friends of the institution, since most of the endowment funds are restricted to the maintenance of the building, the scientific staff and the research work being conducted by them. The accounts reveal that these special donations amounted to more than £3000; the total expenditure for the year was about £18,000. Four hundred and four new members were elected during the year.

THE 'Before Easter' lectures at the Royal Institution will commence on Tuesday, Jan. 15, at 5.15 P.M., when Dr. F. A. Freeth begins a course of two lectures on critical phenomena in saturated solutions. On Tuesday, Jan. 29, Prof. J. S. Huxley delivers the first of six lectures on evolution and the problem of species; on the following Tuesdays there will be two lectures by Dr. S. W. Kemp on Antarctic whaling investigations. On Thursdays there are to be two lectures by Major Gordon Home on Roman London; three by Sir William Bragg on the early history of X-rays; and two by Prof. A. O. Rankine on physics in relation to oil finding. The Saturday afternoon lectures include four by Sir Ernest Rutherford on molecular motions in rarefied gases. The Friday evening meetings will commence on Jan. 18, when Sir William Bragg will deliver a discourse on further progress in crystal analysis. Succeeding discourses will probably be delivered by Prof. A. C. Seward, Prof. J. L. Myres, Mr. C. E. R. Sherrington, Dr. E. K. Rideal, Dr. F. A. Bather, Sir Robert Robertson, Prof. T. F. Tout, Prof. V. M. Goldschmidt, and Sir Ernest Rutherford.

PROF. G. KŒNIGS, professor of physical and experimental mechanics at the Sorbonne, Paris, has been elected an associate of the Royal Academy of Belgium.

PROF. EDMUND B. WILSON, of Columbia University, New York, has been awarded the Daniel Giraud Elliott medal of the U.S. National Academy of Sciences, for the "most meritorious work in zoology or palæontology" for the third edition of his "The Cell in Development and Heredity."

THE council of the Royal Anthropological Institute has awarded Rivers' Memorial Medals for 1928 to Mr. Sidney H. Ray and Mr. E. Torday. These medals are given for work in anthropology in the field of outstanding merit. The award to Mr. Ray is in recognition of his research in the linguistics of Papua and Melanesia, a subject on which his knowledge is

certainly unique. Mr. Ray was a member of the Cambridge Anthropological Expedition to the Torres Straits in 1899, of which Dr. A. C. Haddon was the leader. Mr. E. Torday receives the medal in recognition of his work in the Belgian Congo, where he conducted an expedition which collected a mass of information relating to the social organisation and religious beliefs of the tribes and brought back a remarkable collection of ethnographical objects, some of which revolutionised previous ideas of the capabilities of the African as an artist.

RECENT appointments to scientific and technical departments made by the Secretary of State for the Colonies include three assistant conservators of forests: Mr. R. V. H. Porter to Nigeria, Mr. A. K. Gibbon to Tanganyika Territory, and Mr. F. S. Walker to the Federated Malay States. Mr. C. B. Taylor has been appointed a superintendent, Agricultural Department, Nigeria, and Mr. R. H. Cowan, produce inspector in the same Department. Mr. R. M. Maynard has been appointed district agricultural officer, Tanganyika Territory. Among recent transfers and promotions notified are the following: Mr. H. A. Tempany (director of agriculture, Mauritius) to be director of agriculture in Malaya; Mr. H. B. Waters (deputy assistant director of agriculture, Nigeria) to be deputy director of agriculture, Gold Coast; Mr. G. N. A. Hall (veterinary pathologist, Uganda) to be veterinary pathologist, Nigeria. Mr. W. Allan has been appointed assistant research officer, Northern Rhodesia.

CATALOGUE No. 510 of Messrs. Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, is of bibliographic interest, being devoted to early newspapers, magazines, periodicals, and journals of learned societies. A few of the items relate to scientific publications.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A principal of York Technical Institute—The Secretary, Education Offices, York (Dec. 29). Two junior research assistants in the High-Pressure Gas Research Laboratories of the Department of Chemical Technology of the Imperial College of Science and Technology—The Registrar, Imperial College of Science and Technology, South Kensington, S.W.7 (Dec. 30). A junior lecturer in metallurgy in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Jan. 15). A principal of the School of Science, Technology, Commerce, etc., of the Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth (Jan. 19). A secretary of the North-Western Polytechnic—The Clerk to the Governors, North-Western Polytechnic, 3 Temple Gardens, E.C.4. A junior assistant under the Directorate of Radiological Research, Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A temporary librarian at the Leicester College of Technology—The Registrar, Colleges of Art and Technology, Leicester.

Our Astronomical Column.

CHARACTER FIGURES OF SOLAR PHENOMENA.—The first number of a *Bulletin for Character Figures of Solar Phenomena* has just been issued from Zurich under the auspices of the International Astronomical Union. It was resolved at the Leyden meeting of the I.A.U. to publish a quarterly bulletin of solar data, so that investigators might, with as little delay as possible, be provided with daily index figures of solar activity, much in the same way that the De Bilt figures furnish magnetic data.

The first bulletin, covering the period January–March 1928, contains for each day, whenever possible (1) the relative spot numbers for the whole disc and for a central zone between the meridians 30° east and west of the sun's central meridian; (2) a measure of the intensity of the sun's ultra-violet radiation; (3) character figures expressing the area and intensity of calcium flocculi in the central zone of the disc; (4) and (5) similar character figures for bright Hα flocculi and dark Hα flocculi respectively. There are a number of contributing observatories, and the bulletin is compiled by Prof. W. Brunner, of the Federal Observatory, Zurich. Those engaged in tracing solar-terrestrial relationships will have a useful source of current solar data provided quarterly by these bulletins.

MATHEMATICAL TABLES.—The *Handbook of the British Astronomical Association for* 1929 contains a list of tables by Dr. L. J. Comrie, chief assistant at the *Nautical Almanac* Office, together with notes and comments on the special features of each. He is such an expert in the use of tables that his experience is of great value. He himself, in conjunction with Prof. Milne-Thomson, is bringing out a volume of 4-figure tables which will be more extensive than any existing 4-figure tables and will include hyperbolic and inverse trigonometrical functions.

The increasing use of calculating machines has once more brought natural functions into importance; Brandenburg, Gifford, and Hayashi have all brought out tables of this kind; the last two extend to 8 decimals. The increase of accuracy in some fields of astronomy makes this degree of accuracy advisable. Bauschinger and Peters brought out logarithm tables to 8 decimals several years ago; Dr. Comrie informs us that Peters has also prepared an 8-figure table of sum-and-difference logarithms, but this is held up for want of means of publication. The publication of the present list may be useful in such respects as this by helping to put prospective purchasers in touch with the publishers.

CAPE CATALOGUE OF 4569 STARS.—This catalogue is based on observations made with the reversible transit circle at the Cape between 1918 and 1925. Observations of the sun, Mercury, and Venus indicate a correction of about $-0 \cdot 05$ sec. to Newcomb's equinox. Similar corrections have been found at other observatories; it is not applied in this catalogue, which is still based on Newcomb's value. The stars in this catalogue are all contained in Boss's preliminary general catalogue. They show a close agreement with Eichelberger's fundamental catalogue; this is to be expected owing to the high weight given by Eichelberger to the Cape observations; many of those in the present catalogue had been used by him. The correction found to Boss's declinations between 10° and 30° north decl. is $0 \cdot 44''$, in fair agreement with $0 \cdot 51''$ given by the recent Greenwich Altazimuth catalogue.

Research Items.

ELECTRICAL REPRODUCTION OF SPEECH.—The production of sound pictures has made it necessary for research engineers to study very closely the fundamental principles of speech, hearing, and music. In the United States there is now a Society of Motion Picture Engineers, and some of the papers read before it are reproduced in the *Bell Laboratories Record* for November. Such problems as sound recording, wax recording, recording with the light valve, speed control, sound projector systems, and the fundamental principles of speech, hearing, and music are discussed in an able and interesting way. Studies on the wave forms of speech sounds have shown that the pitch of a man's voice is of the order of 128 cycles per second, whilst that of a woman is of the order of 256 cycles. In both cases overtones occur. Woman's speech is more difficult to interpret than man's. This may be partly due to the fact that it does not disturb the membrane of hearing in so many places. The more difficult consonant sounds in woman's speech are not only fainter, but also require a higher frequency range for interpretation. When by electrical methods frequencies below 100, 200, . . . 1000 cycles are progressively eliminated from speech, its character changes in a marked way. Timbre or 'tone colour' best describes the characteristic lost. For the correct interpretation of speech sounds, frequencies below 300 cycles do not appear to be necessary. When frequencies above 8000, 7000, . . . 3000 cycles are progressively eliminated, the character of the speech again changes markedly. The characteristic lost may be described as sibilance. It refers to the hissing or frictional character of speech. The impairment produced by eliminating higher frequencies is generally greater in the case of female voices. Timbre seems to be more important in music than in speech. In order to distinguish the tones of various instruments, the fundamental and the first three or four overtones are essential.

FISHES FROM THE PHILIPPINES.—In the *Philippine Journal of Science*, May 1928, Mr. Albert W. Herre and Mr. Heraclio R. Montalban describe twenty-two species of Goatfishes (The Goatfishes, or Mullidæ, of the Philippines). This family includes upwards of forty species belonging to five closely related genera, three of which, *Upeneoides*, *Upeneus*, and *Mulloides* occur in the Philippines. They are shore or reef-dwelling fishes found in all warm seas and living on the sea bottom, where they feel and test everything with their two long barbels as they search for food, which consists of small crustacea and fishes. All are coloured in the most gorgeous way with characteristic patterns of various spots and stripes and are some of the most striking and beautiful fishes in existence. Many of them are valuable food fishes, reaching to a size of 300 or 400 millimetres. The paper is well illustrated by one uncoloured and five coloured plates. In the same journal for June, one of the authors (Mr. Herre) deals with the Belonidæ (the Philippine Gars or Needlefishes). Like the British Garfish, the body is more or less green, the flesh and bones being green also. One species of *Ablennes* and eight of *Tylosurus* are described in detail. They live near the surface and are exceedingly voracious and carnivorous, but prey only on small fishes (chiefly atherines, anchovies, and pilchards), the gullet being very narrow. The larger gars are valuable food fishes, and may reach a length of more than one and a half metres. Also in the June number, Mr. Abelardo Valenguela discusses the composition and nutritive value of Philippine food fishes. Approximately one-tenth of all the known fishes are found in Philippine waters, most of which are edible. From the investigation of forty species of fresh fishes, the author finds an average protein content of 20·15 per cent, while smoked or dried fish (six species) has as much as 44·92 per cent. Fresh fish has an average fuel value of 99·02 calories; smoked or dried, 237 calories per 100 grams. Some of the commoner shell-fishes were also analysed.

INSECTS OF SAMOA.—Since last referred to in our columns, six further fascicles of "Insects of Samoa," in course of publication by the British Museum (Natural History), have appeared. In Part 6, Fasc. 2, dealing with the Nematocerous flies, Mr. F. W. Edwards mentions that only eleven species were known prior to 1926, and with the material now available the list is raised to one hundred. He concludes that the Samoan fauna of these insects is purely of Austro-Malayan origin. Regarding the Thysanoptera (Part 7, Fasc. 2), Mr. R. S. Bagnall notes that with one exception the species either form leaf-galls on *Ficus* or are inquilines thereof, and all the species are described as now. The Geometrid moths studied in Part 3, Fasc. 3 by Mr. L. B. Prout bring up the known Samoan species of that family to thirty: they are included in eighteen genera, none of which is endemic or even restricted in its range. In Part 7, Fasc. 3, dealing with the Neuroptera, Mr. P. Esben-Petersen adds twelve species to the Samoan fauna which belong to the three families Chrysopidæ, Hemerobiidæ, and Myrmeleonidæ. He remarks that, as a whole, these insects indicate close relationship with the Austro-Malayan fauna. The Apterygota are dealt with in the same fascicle: they present no startling novelties, and Dr. G. H. Carpenter finds only eight species, of which two Thysanura and one Collembolan are new. Other reports deal with Hemiptera, Anoplura, Mallophaga, Trichoptera, Plecoptera, Siphonoptera, Orthoptera, and Dermaptera, and are written by leading specialists in the groups concerned.

ENGLISH-GROWN PYRETHRUM.—In the *Annals of Applied Biology*, vol. 15, No. 3, August 1928, Messrs. J. C. F. Fryer, F. Tattersfield, and C. T. Gimingham contribute the first part of an interesting paper on English-grown pyrethrum as an insecticide. The use of certain species of this plant for insecticidal purposes has been known for some time, and the authors' object has been to determine whether pyrethrum grown under English conditions retains its killing powers. The species *Chrysanthemum cinerariæfolium* was grown from Swiss and Japanese seed, and the flowers from plants grown in six different English localities showed practically the same toxicity from the insecticidal point of view. Artificial drying of the flowers had no significant effect on their properties, although prolonged exposure of pyrethrum to wet conditions led to some loss of toxicity; but contrary to the usual opinion, if stored in a reasonable manner, they remained without deterioration for long periods. The data given in this paper show that pyrethrum can be successfully grown in England and harvested without loss of toxicity under our climatic conditions.

STOCK DISEASES CAUSED BY TOXIC PLANTS.—The importance of plants which are toxic when eaten by his flocks and herds has long been recognised by the stock-owner, and in Great Britain the yew and rhododendron are well known to be poisonous to cattle and sheep. In the Kimberley District of Western Australia a disease of the horse ('walk about disease') has been determined by Mr. Murnane and Prof. Ewart to be

due to slow poisoning by saponin derived by the ingestion of the leaves of a local plant, *Atalaya hemiglauca* (whitewood), a tall shrub or small tree with pinnate leaves belonging to the Sapindaceæ. 'Winton' disease of horses in New Zealand has been shown to be due to the ingestion of ragwort, *Senecio jacobœa*, which is likewise rich in saponin (*Bull.* No. 36, Council for Scientific and Industrial Research, Australia).

TIMBER INVESTIGATIONS.—The investigation work into the properties and strength of home-grown and imported timber being carried out by the Forest Products Research Laboratory at Princes Risborough has been already alluded to in NATURE. In what was designated as *Forest Products Research Project I.*, the mechanical and physical properties of timber, based on experiments with small clear specimens, was dealt with. A second pamphlet on the results attained with tests on British home-grown ash, Douglas fir, European larch, Corsican pine, and Scots pine has recently been issued under the title *Project I.: Progress Report I.* ("Tests on some Home-grown Timbers in their green condition," by C. J. Chaplin. London: H.M.S.O.). It may be suggested that a simplification of the titles of these reports would perhaps result in their being more widely read; or at any rate more readily obtained in a library or elsewhere. For example, the average member of the public, unless he had the two publications before him, would not readily appreciate the fact that the first, termed *Project I.*, and the one under review entitled *Project I.: Progress Report I.* were two different pamphlets. In connexion with the experimental work being undertaken on the above-mentioned timbers, it is stated that the object in carrying out the tests is not primarily to determine the strength of timber as used for commercial purposes (which is dealt with under another series of investigations) but to determine the strength of timber, selected free from all defects. The value of this research work, it is contended, "lies in the fact that it is necessary to select timber free from defects, termed clear timber in *Project I.*, so as to obtain data on the species that will be strictly comparable with similar data of another species." Of the five specimens dealt with, the wood of the ash came from Coleford, Gloucester; the Douglas from Taymount, Scotland; the European larch from the Forest of Dean, Gloucester; the Corsican pine from Wells, Norfolk; and the Scots pine from Bedgebury, Kent. The localities chosen for the larch and Scots pine appear to be curious. It might have been confidently expected that the latter at least would have come from Scotland, and the former from a locality where larch has been grown over a far more extensive area than has been the case in the Forest of Dean. Mr. Chaplin's work has been carried out with considerable care and the results attained are of interest.

NATURE RESERVES IN NEW ZEALAND.—The policy of making State-owned reservations for the protection of scenic features and the preservation of flora and fauna is steadily pursued in New Zealand. Since 1904, nearly half a million acres have been acquired for these purposes at a comparatively small expense to the State. The number of reserves is now 806, including about eleven thousand acres added during the last year. These recent additions are described in the Scenery Preservation Report of the New Zealand Department of Lands and Survey for the year 1927–28. Many of the reserves are small, and some of these are of no value for cultivation. Others are not easy of access at present, but will be appreciated as settlement increases. The supervision of most of the reserves is delegated to local authorities or specially constituted local boards. In some of the reserves there are specially appointed caretakers. The report concludes with an account of the present state of the fauna and flora of Kapiti Island, at the western end of Cook Strait.

EXTERMINATION OF BRACKEN.—Many acres of grassland are rendered useless for grazing in Great Britain by the growth of bracken, which largely prevents the growth of the grasses as a result of the dense shade thrown by its fronds, whilst their dense stiff foliage excludes the sheep. At the same time, the extermination of this plant, although its normal habitat may be the deeper soils of the natural woodland, presents many practical difficulties. Dr. W. G. Smith gives the results of some recent experiments upon the farm of the Edinburgh and East of Scotland College of Agriculture in the *Trans. and Proc. Royal Botanical Soc. of Edinburgh*, **30**, 3-12, 1928. Cutting has proved most effective if carried out when the fronds had grown up for about seven or eight weeks. They have then taken a maximum amount of food from the underground rhizomes and not yet commenced to replenish these supplies as the result of their own photosynthetic activity. Sheep have also been induced to graze down the young fronds by dressing the ground with crushed rock salt. A hopeful preliminary experiment is also described where the young fronds were destroyed by a dressing of potassium chlorate.

FOSSIL BACTERIA.—In 1922, Prof. Hans Schneiderhöhn (*N. Jahrb. f. Mineral.*, Beil.-Bd. **47**, pp. 1-38) announced the discovery of sulphur bacteria in the Permian copper-shales of Mansfeld in Saxony. Mr. Sven V. Bergh now publishes in *Geologiska Foreningens i Stockholm Förhandlingar* (**50**, pp. 413-418) photographs of polished sections of Ordovician alum-shales from Kinnekulle, Sweden, seen by reflected light. They show small, somewhat rounded, fragments of bituminous substance, closely surrounded by minute grains of pyrites. These grains also occur in roughly spherical aggregates. In the opinion of Mr. Bergh, Prof. Schneiderhöhn, and some unnamed bacteriologists, these are fossilised sulphur bacteria.

PALÆOZOIC BRACHIOPODS.—In a memoir on *Plectambonites* and some allied genera (*Mem. Geol. Survey Gt. Britain*, Palæont., vol. 1, pt. 6, pp. 367-527, plates 21-25; 1928) Prof. O. T. Jones describes in great detail the morphology, classification, affinities, and distribution of some late Ordovician and Silurian Brachiopods, many of which have hitherto been referred to the genus *Plectambonites* which was founded on Ordovician species. The limitations of that genus are discussed, and it is shown that the forms of later age should be separated from it. Three new genera are established, *Leptelloidea*, *Sowerbyella*, *Chonetoidea*, and many new species are described. *Plectambonites* is reminiscent of *Billingsella*, and it is probable that both genera are descended from a common ancestor. The *memoir* concludes with two tables, one showing the correlation of the divisions of the strata from the Llandeilo to the Ludlow in Great Britain, the other giving the geological ranges and localities of the species described.

THE ETIGO (JAPAN) EARTHQUAKE OF OCT. 27, 1927.—Though not of great strength (intensity 9, Rossi-Forel scale), this earthquake showed some features of considerable interest. According to T. Matuzawa (*Earthq. Res. Inst. Bull.*, vol. 5, 1928, pp. 29-34), it occurred at 1h. 53m. 35s. G.M.T. The devastated region was very small, so that the position of the epicentre could be determined precisely, as in lat. 37° 27′

N., long. 138° 46′ E., that is, close to the north coast of Japan, a short distance to the west of Nagaoka. At the request of Prof. A. Imamura (*Tokyo Imp. Acad. Proc.*, vol. 4, 1928, pp. 56-59), the precise levelling over about 170 miles of the Etigo province had been carried out about three months before the earthquake. It was repeated over the central area soon afterwards, when it was found that over a distance of 2½ miles, including the epicentre, there had been an upheaval of 2·1 cm. or about four-fifths of an inch. This change may be taken as wholly due to the earthquake, the first result of the kind quite free from error due to secular variations of land-level. Mr. Matuzawa has also examined the records from 23 stations in Japan (*Earthq. Res. Inst. Bull.*, vol. 5, 1928, pp. 1-28), and finds that the velocity of the earth-wave in the upper or granitic layer was 4·99 km. per sec., and in the layer below 6·4 km. per sec. The depth of the focus cannot be estimated with accuracy, but it was apparently about 12 miles.

A NEW TRANSIT INSTRUMENT.—Prof. C. V. Boys has designed a new type of transit instrument which embodies the principle of the dipleidoscope in a solid prism (*Proc. Roy. Soc.*, A, 121, Nov. 1). Two stellar images are obtained from the latter, one formed by two internal reflections, and the other by direct reflection from the face of emergence of the internal rays. The two images are thrown on to a moving cinema film by a long focus object glass mounted in the tubular support of the prism, and the beats of a standard clock are also recorded on the film as discontinuities in the stellar trails, produced by the controlled rocking of a plate of glass in the path of the light. Two coincidences are registered, the first with the star about 1′ to the east of the meridian, and the second with the star to the same extent past the meridian. Prof. Boys has given exact details for the construction and mounting of the instrument—one of the prism's supports is a bar passing through a hole drilled in the glass—and points out that many of the troubles encountered with instruments now in use do not arise. The mechanical requirements of an absolute character are reduced to a minimum, and the crucial point would appear to be whether or not a prism of the necessary perfection for work of this type can be manufactured; a two to one ratio of the angles, and freedom from pyramidal error should each be to within 1′ of perfection.

ATTENUATION OF WIRELESS WAVES OVER LONDON.—An interesting paper by R. H. Barfield and G. H. Munro on the attenuation of wireless waves over towns was read to the Wireless Section of the Institution of Electrical Engineers on Dec. 5. The work carried out was part of the programme of the Radio Research Board. To obtain measurements a motor van was employed with a frame coil fitted on the top as a receiving aerial. The strengths of the received signals were indicated by the deflection of a microammeter in the anode circuit of the detecting valve of an amplifier. When occasion offered, a few experiments were made on the effects of trees and wires. In most cases their proximity resulted in a reduction in the signal strength and also in a flattening of the minimum of the curve obtained by rotating the aerial coil. In one case, beneath a set of telephone wires, the minimum exceeded fifty per cent of the strength of the maximum. An interesting new radio contour map of 2 LO (London) made in March 1927 was given. The earlier map (1926) was constructed mainly by taking observations in seven radial directions at equal angular intervals round the transmitter and interpolating for the intermediate spaces. Blind directions therefore may have remained undetected. Alterations made in the transmitting aerial also made it advisable to construct a new map. Over the greater part of the area the changes are slight. The chief point of difference is the appearance in the later survey of two distinct 'crevasses' in the contour lines in the directions west-south-west and east-north-east from the transmitting station. These are almost certainly produced by the directional properties of the 2 LO aerial, and correspond to the minima in a polar curve obtained by the authors and ascribed to mast shadow. These 'blind' directions were probably present during the earlier survey and were undetected owing to the method of observation adopted.

WIRED WIRELESS TELEPHONY.—In view of the increasing demands continually being made on the overcrowded ether, researches are being made for further channels for broadcasting which will not congest the ether further. So far back as 1900, Duddell realised that his whistling arc not only solved the problem of wireless telephony, but might also be utilised to transmit music, produced by a band playing in an electric lighting station, into the houses of all connected to the station, the electric currents producing the vibrations being carried by the lighting mains. This was an early illustration of 'wired wireless.' In the *Wireless World* for Nov. 14 and 21 the underlying principles of this system, sometimes called wireless wave telephony, are explained. The high frequency oscillations developed by some suitable type of high frequency generator are used. They are modulated by the currents produced in a microphone by speech or music. The resulting modulated oscillations, instead of being radiated into space from an aerial as in radio telegraphy, are introduced into a land line circuit along which they are transmitted as electro-magnetic waves. A recently suggested application of wired wireless is the broadcasting of programme matter over existing wire networks without interfering with the main services for which the wires are intended. Although at present there are few commercial applications of the method, the Western Electric Co. of America has worked out in detail and patented (Brit. Pat. 192.359), a complete wired wireless system utilising the ordinary telephone wires. Several broadcasting programmes can be superimposed on a telephone system without interfering with its ordinary use by subscribers. Electric filters are essential for this method. As a rule these are complicated and expensive. If, however, a power or lighting system like the British 'grid' were employed, these filters would be unnecessary.

THE ATOMIC WEIGHT OF BORON.—Briscoe, Robinson, and Stephenson (1926) concluded that the atomic weight of boron depended on its source. Their determinations involved the densities of beads of fused boric oxide and the different densities observed could not be explained by temperature changes. The *Journal of the Chemical Society* for October contains a paper by A. Cousen and W. E. S. Turner, in which these results are criticised on the grounds that the fused beads were not free from strain. The density of fused boric oxide is now found to be about 1·844, while Briscoe, Robinson, and Stephenson found it to be 1·795. Cousen and Turner show that this difference is probably due to the careful annealing of their beads, which were also prepared at a higher temperature (1400°). In view of the difficulty with which the last traces of water are eliminated from boric acid, this may further contribute to the discrepancy. It appears that the densities of boric oxide glass cannot be relied upon as evidence that the atomic weight of boron varies according to the source of the mineral containing it.

Cancer Research.

IN the twenty-sixth annual report of the Imperial Cancer Research Fund, the Director, Dr. J. A. Murray, reviews certain aspects of the cancer problem with special reference to the contributions made by members of the scientific staff of the Fund. He points out that although cancer is at its inception a local disease, a factor of general susceptibility or resistance also plays a part in the development of, or failure to develop, a tumour. The response to a local irritation, if it occurs, is the appearance of a growth at the site stimulated; early removal will result in complete cure, even though the growth may be of a typically malignant character. Such cure is observed not only in mice painted with tar, but also in human beings, provided the operation is carried out at the earliest stages of the development of the tumour. But tar-painting only produces a neoplasm after different intervals in different mice: some fail to develop one even after a year's painting. If the growths are removed from a number of mice in which they have appeared soon after the commencement of the course of tarpainting, it is found that these animals are distinctly more resistant to a second course of tarring. A similar resistance to a subsequent course of tarring is also observed in mice which have suffered from a spontaneous mammary cancer, after the successful removal of the latter. This last experiment proves that the increased resistance is not due to a change in the cells of the skin alone, but to a general constitutional factor.

The existence of this factor of susceptibility or resistance in man is disclosed by two different sets of observations: first, multiple malignant new growths in a single individual are extremely rare; secondly, the incidence of tumours in males and females in different countries strongly suggests that a certain number of the population are susceptible to the disease, but that the actual site at which it will appear depends on factors of race and environment. In England, Holland, Japan, and Switzerland the incidence of cancer is about the same in men and women, and varies from 1·0 to 1·2 per 1000 living. In the male, however, the majority of the tumours observed are found in some part of the digestive tract: in the female the incidence here is lower, but is very much heavier in the specific sex organs, especially the uterus and breast; 20-40 per cent of all cases of cancer in women occur in these organs. Thus, so to speak, the heavier incidence in the specific female organs is compensated by a lower incidence in the digestive tract. At the same time the incidence in breast and uterus varies in different countries: cancer of the breast is commonest in Englishwomen, rare in Japanese, and only half as common in Dutch women; cancer of the uterus is very prevalent in Japanese, but only half as common in Dutch as in English women. The lower incidence of cancer of the specific organs in Dutch women is, however, accompanied by an increased incidence in the digestive tract, so that the total mortality is about the same as in English women. These observations strongly suggest that the incidence of cancer is determined by general factors of susceptibility, but the actual organ in which it appears by local factors varying according to the environment in its widest sense.

Dr. Murray states that his colleagues have been unable to demonstrate any connexion between malignant growths and dietetic deficiencies. Old rats, or rats kept on diets deficient in vitamins A or B, frequently develop papillomata and warts of the epithelial lining of the fore-stomach, but no malignant tumour has ever been observed. He considers, in fact, that there is no trustworthy evidence, experimental, statistical, or clinical, of a causal correlation between cancer and the absence, or presence, or excess of any particular dietetic constituent, in spite of statements to the contrary frequently made.

During the year Prof. Heidenhain stated that he had been able to transmit cancer from man to animals by injecting a large number of mice with human cancerous material. After a considerable interval a certain number of these mice developed tumours; however, the incidence of these growths was similar to that of spontaneous neoplasms in the stock of mice maintained by the Imperial Fund, so that Heidenhain's growths must be considered to be spontaneous new developments, and not as originating directly from the human material injected.

The glycolysis produced by cancer cells in the presence of oxygen does not appear to be a specific phenomenon: virus infections resulting in cellular overgrowth also show glycolysis, whilst those in which this overgrowth is absent fail to show this characteristic. It appears, therefore, that an aerobic glycolysis is not restricted to cancer, but occurs also in other types of pathological cellular overgrowth. The majority of normal tissues only show this phenomenon in the absence of oxygen.

Exposure to low oxygen pressures results in delayed growth and extensive necrosis of tumour cells, but even prolonged exposure fails to arrest the growth completely, and regression has never been observed. As a possible treatment of cancer this method is therefore without therapeutic value by itself (although it might be useful as a supplement to other methods of treatment).

Report of the Forestry Commission.

IN their eighth annual report, the Forestry Commissioners give a record of the work accomplished in Britain during the year ending Sept. 30, 1927. The planting programme, which has formed the chief of their activities, was continued. On the subject of finance, the report shows that out of the total of £3¼ millions sanctioned in 1919 for a ten years' programme to be paid before Mar. 31, 1929, £3,014,400 had been allotted up to Sept. 30, 1927, leaving £485,600 still to be provided. The Treasury had since intimated that this balance would be made available for the financial year 1928–29, which, with a balance of £136,000 estimated to be in hand on April 1, 1928, gives a sum of £621,600 for the possible expenditure during 1928–29.

The land acquisitions amounted to 36,039 acres during the year, of which 30,755 acres were classified as plantable. The total land acquired between 1920 and 1927 amounted to 391,511 acres, of which 244,838 acres were classified at the time of acquisition as plantable; 155,208 acres of this latter land are leased and 109,630 acres have been purchased. Of the plantable area, 140,756 acres (57 per cent) are situated in England and Wales and 104,082 acres (43 per cent) in Scotland. In spite of the smaller amount of planting land in the latter, the total acreage, leased and purchased, acquired in Scotland amounts to 233,667 acres as against 157,844 acres in England and Wales. It is at least open to doubt whether the Commissioners are acting wisely in thus saddling themselves with so large an area of unplantable land in the early years of their existence.

As is well known, the main idea governing the Commissioners' work so far has been the acquisition of land and the formation thereon of coniferous plantations, the original programme being to plant 150,000 acres in the ten-year period. For reasons detailed in previous reports, there was a check in the work. The area planted during the year under review amounted to 21,963 acres of conifers. It is estimated that 135,000 acres will have been afforested with conifers by the end of the ten years, of which 90,156 acres had been planted by the end of the eighth year, with, in addition, 4130 acres of broad-leaved species (hard woods); or a total of 94,289 acres. The report adds that a total area of approximately 117,300 acres had been completed by May 1928. It was proposed in the original programme that assistance should be given, by way of grants, to local authorities and private owners to afforest areas under their control, an area of 110,000 acres being prescribed for the ten years. About 62,000 acres have been more or less dealt with, and it is hoped to achieve a total acreage of 75,000 by the end of the ten years. The work on the provision of forest worker's holdings has proceeded. The systematic formation of these holdings was commenced in the summer of 1924. Up to September 1927, 357 holdings had been completed (171 in the year under review), and 219 were in process of formation.

The cost of planting still remains very high. The report says that the outlay per acre on labour and material on the area planted between 1919 and 1927 was as follows: England and Wales, £8 : 9 : 9; Scotland, £9 : 10 : 3; Great Britain, £8 : 16 : 4. These figures include the cost of preparation of the ground, drainage, fencing, plants, planting, replacement of failures, and weeding. It is noticeable that during 1927 the expenditure on replacing failures (beating up) was something over 25 per cent of the cost of original planting, a decrease on 1926, when it was nearly 50 per cent; the figure is, however, excessive, and few private owners could undertake afforestation if they had to face so high a proportion of failures.

The Commissioners have scarcely faced the question of undertaking a part of their work by direct sowing, of which few adequate experiments have yet been made; and yet it would appear that it is in this direction that the true solution of the afforestation question is to be sought. With high planting charges and nurseries costing as much as half the total expenditure entailed on the cultural operations (£351,046 as compared with £675,889 for the eight years), it is difficult to foresee how an adequate area of forests will be obtainable with the amount of money which the tax payer is likely to be able to devote to this forestry work, necessary as it is to the future welfare of Great Britain.

Moray Firth Fisheries.

THE Fishery Board for Scotland has recently issued two important papers dealing with commercial fishing in the Moray Firth. The first is a review of the cod-net fishing,[1] and the second is an account of the Danish seine-net fishery.[2] Prepared by so able an authority as Dr. Alexander Bowman, these two papers contain much interesting and valuable practical information. Read together, they demonstrate very clearly the great extent to which the prosecution of both cod-net fishing and Danish seine-netting has been influenced by the prevailing economic conditions of the great Scottish herring fisheries.

Between herring seasons, other work must be found for the steamers and motor craft, which need to be kept in almost constant commission to meet expenses; they cannot be laid up with the same facility as the older sail boats. Thus cod-net fishing, begun in the Moray Firth in the year 1906, attracted little attention until two or three years later, when the fact had become more generally realised that remunerative results were being obtained at a time of year when there is a general lull in herring fishing. Even then, one disastrous season in 1911 so weakened the confidence of the crews of the steamers that, in the following year, fewer steamers were fitted out for the fishery, although cod entered the area in considerable numbers. Moreover, the fact that their subsequent return to the fishery has been slow, seems to suggest that, as yet, confidence in the method has not been fully regained.

The method of fishing by means of the Danish seine was first introduced into Scottish waters in the autumn of 1921. In that year, during the coal strike, a large number of Danish motor boats using the seine landed good catches at English ports, and even after bunkers again became available to trawlers, these small vessels proved able to compete successfully in the market. The Danish net was therefore rapidly adopted, at first by English vessels and almost immediately thereafter by a number of Scottish steam-drifters and motor boats. The vessels normally employed in the Scottish drift-net fishery being especially suitable for the use of the light Danish seine and easily convertible at comparatively small expense, both steam and motor drifters from Moray Firth were rapidly equipped with the new gear, and fishing was soon being carried on energetically in local waters. The adoption of the method was accelerated by the acute depression prevailing in the herring-fishing industry at the time. The intensity of fishing which characterised the early operations was, however, not maintained, and, in 1923, the total number of landings fell short of that of the previous year, but in the following years there was no sign of further decline. With the large number of power vessels adopting the Danish seine, it became a question of some interest whether or not the new method would supplant the older one of cod-net fishing. The innovation is of too recent a date, however, to permit a definite answer to be given at present.

[1] "Review of the Cod-net Fishing in the Moray Firth." *Fisheries, Scotland, Sci. Invest.*, No. 1; 1928.

[2] "Danish Seine-net Fishing in the Moray Firth." *Fisheries, Scotland, Sci. Invest.*, II.; 1928.

Liverpool Observatory and Tidal Institute.

AN agreement has just been made between the Mersey Docks and Harbour Board and the University of Liverpool for the administration as a single institution of the Board's Observatory at Bidston and the Tidal Institute of the University. The combined institution is to bear the name of "The Liverpool Observatory and Tidal Institute" and will be governed by a joint committee of the Dock Board and the University.

The Liverpool Observatory was founded in 1845, and since 1867 it has been situated on Bidston Hill, near Birkenhead. The work carried on has always been intimately associated with the activities of the port, much attention being given to time-measurement

and distribution, together with the testing of chronometers and navigational instruments. Though in the past the director has always been primarily an astronomer, changing conditions have made the Observatory mainly a meteorological station with a regularly working seismograph.

The Tidal Institute was founded so recently as 1919, and its work has often been referred to in our columns.

Five years ago an agreement was made between the Dock Board and the University whereby both these institutions were placed under the government of a joint committee of the Board and University, and a large measure of co-operation has resulted. For example, the tidal predicting machine has been housed in the Observatory building, so that the major part of the work of constructing tide-tables has been done at Bidston. The new arrangement, which comes into force on Jan. 1, goes much further than this and completes the association of these two types of scientific activity. The work in meteorology and seismology hitherto carried out at the Observatory will be continued, the testing of chronometers and instruments will be undertaken, and the time-gun at Birkenhead will be fired as heretofore.

The last director of the Observatory, Mr. W. E. Plummer, died a few months ago. The new combined institution will have for director Prof. J. Proudman of the University of Liverpool, and for associate director Dr. A. T. Doodson, who will reside at the Observatory. The total scientific staff will consist of five men and three women.

Properties of Electrons.[1]

C. G. Darwin.—(1) On the magnetic moment of the electron. Starting from the wave equations for an electron and the associated electric density and current, it is shown how the electromagnetic fields of a moving electron can be attributed partly to the convection of electricity and partly to an intrinsic magnetisation. A geometrical construction shows the relation between the wave constants and the magnetisation. The formulæ, first worked out for slow motion, are easily generalised by relativity for high speeds, and in this case there are electric as well as magnetic moments, and various invariant properties are given.

A comparison is made between an electron wave and a light wave, and the resemblance may be loosely expressed by saying that a light-quantum is an electron without charge or mass.

(2) On the diffraction of the magnetic electron. The problem is solved of the diffraction of an electron wave by a line-grating exerting periodic electric or magnetic forces; this represents the essential features of diffraction by a crystal. The incident wave is supposed to be magnetised in a definite direction, and it is shown that, when the grating exerts only electric forces, the effect is to rotate the direction of magnetisation through a definite angle about an axis perpendicular to the incident and diffracted rays, and no polarisation can be produced by the diffraction. For some magnetic forces a similar rotation occurs, but in general the simultaneous action of electric and magnetic forces may produce a partial polarisation, though the case is too remote from experiment to be worth treating in detail.

G. Temple.—The scattering power of a bare nucleus according to wave mechanics. A direct proof is given of Mott's result (*Proc. R. S.*, vol. 118, p. 542) on the scattering of an infinite plane wave by a bare nucleus. The accurate expression for the incident and scattered waves is obtained, together with the complete asymptotic expansion, leading to a rigorous proof of Rutherford's formula for the scattering power. The same problem is briefly considered on the basis of the relativistic wave equation, and the necessary modification of Rutherford's formula is obtained to the usual approximation, neglecting the terms involving the square of the electrostatic potential.

J. E. Lennard-Jones and H. J. Woods.—The distribution of electrons in a metal. The distribution of electrons in a two-dimensional metal is worked out by statistical methods on the assumption that the assembly of electrons is 'degenerate' in the sense of Fermi and Dirac.

[1] Abstracts of papers read before the Royal Society on Nov. 1.

University and Educational Intelligence.

Birmingham.—Dr. Leonard G. Parsons, physician to the General Hospital and senior physician to the Children's Hospital, has been appointed professor of infant hygiene and diseases of children.

The Council has approved an expenditure of about £300 for the preparation of a laboratory to be used specially for tissue culture in connexion with the Department of Physiology.

From October 1929 there is to be a considerable reduction of fees for engineering students.

The degree of D.Sc. has been conferred on R. H. Hopkins for contributions to biochemistry.

Cambridge.—Prof. Eddington, Mr. Landon, Mr. R. H. Fowler, and Mr. Rideal have been appointed members of the council of the school of physical sciences, and Sir F. G. Hopkins, Prof. T. B. Wood and Mr. C. F. Cooper have been appointed member of the council of the school of biological sciences.

Edinburgh.—At a graduation ceremony on Dec. 14 the degree of D.Sc. was conferred upon Sunder La Hora (Assistant Superintendent, Zoological Survey o India) for his thesis on "Ecology, Bionomics, an Evolution of the Torrential Fauna, with Specia Reference to the Organs of Attachment"; and o Richard Maclean, for his thesis on "Strengthening o Certain Important Bridges of Main Line of Bombay Baroda, and Central India Railway."

Liverpool.—At the meeting of the Council of th University on Dec. 11, Prof. J. H. Dible, professo of pathology and bacteriology, Welsh National Schoo of Medicine, Cardiff, was appointed to the Georg Holt chair of pathology.

At the same meeting Prof. Warrington Yorke, wh has held the Walter Myers chair of parasitology i the University since 1914, was appointed to th Alfred Jones chair of tropical medicine as fro Jan. 1, 1929.

Manchester.—The council has accepted the resi nation of Dr. Stuart Thomson, senior lecturer zoology; Dr. Stuart Thomson has been a memb of the staff of the Zoological Department since 1910

The Council has elected the following to honora research fellowships in physics: Dr. A. G. Bradle Dr. Szabo V. Naray, Dr. Felix Machatschki, Mr. West, and Dr. W. H. Zachariasen. The followi have been awarded elected research studentship Mr. Harold Walkden (in botany), Dr. Werner Albrec (in physics).

The Phonetic Institute of the University of Vien has assigned tables for foreigners who wish to stu their own speech by the graphic method. Four tab are now used for Czechisch, Hungarian, Yiddish, a Hindustani. Two others are available. Applicati may be made to the Director, Prof. E. W. Scriptu Strudelhofgasse 4, Vienna.

Calendar of Customs and Festivals.

December 22.

ST. DECLAN.—The festival of St. Declan at Ardmore was at one time one of the most frequented and at the same time one of the most conspicuously pagan of the popular religious observances in Ireland. The holy stone of St. Declan in Ardmore Bay stood on a number of irregular stones like pillars, and could only be reached at low tide. The worshippers, who numbered thousands, passed under it three times, crawling on bare knees. Each time they emerged they struck their backs three times against the rock while they repeated Aves. They also circuited the round tower and the house in the graveyard in which the saint was buried, and kissed the stone cross.

December 24.

CHRISTMAS EVE.—Carol Singing.—The custom of carol singing is one of considerable antiquity in the Church, sometimes in early days the office being performed by the bishop. Judging from some of the children's songs which have survived, a song of greeting or chant in addition to the cry of 'Yule' may, in northern England or Scotland, have formed part of the midwinter ritual, and there is a tradition that the Druids sang some form of chant at the cutting of the mistletoe. The boar's head was often introduced in the dining hall to the singing of a carol. In Rome it was once the custom of the shepherds of the Campagna to come in to play their pipes before the shrines of the Madonna. In England the waits were often composed of the church band or choir, and their religious character emphasised by remaining in church until twelve o'clock before going on their rounds.

December 25.

CHRISTMAS DAY.—In the Julian Calendar the day of the winter solstice, and in the sun cult, *i.e. Dies Natalis invicti solis* or *solis novi*, when both in Egypt and in Syria feasts were held and a ritual observed in which the birth of the sun was hailed with the cry, "The virgin has brought forth! The light is waxing!" The identification of the god Mithra with the sun, and the spread of his worship throughout the Roman Empire, extended still further the recognition of this day as of supreme religious import. Outside the Mediterranean area the pagan festival of midwinter extended over a period of some days, as is shown by the extent to which the twelve days between Christmas and Epiphany are observed as a holiday and a time of portent; while judging from the variations in date in similar and analogous customs in different localities, it is probable that no very precise but only an approximate uniformity prevailed in the date of observance. Yet as Roman and Mithraic influence extended, there would probably be a tendency to give an increasing importance to the exact day in relation to the midwinter festival. It is difficult, however, to discriminate between pre- and post-Christian influences, and the effect of the Mithraic cult among the general population may well have been exaggerated.

There can, however, be no doubt that in the lands in which Christianity first took root, Dec. 25 was a date of great importance in pagan rites, and largely influenced the ultimate choice of that date for the celebration of the Nativity of Our Lord, although the exact date of his birth was uncertain, being placed by some authorities in April and by others in November. The festival of Christmas was not observed in the early Church, and it was not until the fourth century that it became general, and even then with some differences. By the East it was celebrated on Jan. 6 at the feast of the Epiphany, and by the West on Dec. 25. The latter date was made universal by Pope Liberius in the year 353–4. When once the feast had been established, increasing attention was paid to it, and its especially sacred character emphasised by Christian writers in order to distract attention from the pagan observances, which bore so close a resemblance to those of Christmas that both pagan and Christian accused each other of borrowing.

December 26.

ST. STEPHEN'S DAY.—In Germany "Der Grosse Pferdstag," a day associated with the cult of the horse, St. Stephen having been made the patron of horses. According to Hospinian, it was the custom on this day to gallop horses until they were in a sweat and then to bleed them to protect them from any disorders in the coming year. As a set practice this was said to have been introduced into Britain by the Danes. Among the Finns a piece of silver was thrown into the troughs out of which the horses drank on this day. Although it is pointed out in references to this custom that it was convenient at this season owing to the horses being at rest, a magical import is suggested by the belief that it will keep them from harm throughout the year. It may also be viewed in relation to the custom of 'Hodening' in the Isle of Thanet and at Ramsgate, where on Christmas Eve or Christmas Day a head of a dead horse was carried around on a pole by a carol-singing party. The bearer was concealed by the horse cloth, and a string was attached to the lower jaw to make the teeth snap. The hobby-horse was usually a conspicuous figure in the Christmas mumming performances.

Hence St. Stephen's Day was also associated with the chase, and was regarded as a day like Nov. 5 and St. Andrew's Day on which the game laws did not apply. A special 'Boxing Day' meet is still usual.

HUNTING THE WREN.—Although in most European countries the wren is greatly reverenced, and it is considered unlucky to kill it or disturb its nest, in Britain, Ireland, and France it was hunted and killed at Christmas time—on Christmas Eve, Christmas Day, and St. Stephen's Day. Its body was hung on a pole with wings outspread, and it was then carried from house to house. Sometimes those who made a gift of money received a feather for good luck. In the Isle of Man the body was buried solemnly in the churchyard at the end of the day. In the south of France the procession was headed by a 'king of the wren,' the first who had struck down a bird. The custom may be compared with those of primitive peoples in which a sacred animal is killed periodically and carried in procession, as, for example, the bear among the Gilyaks of Siberia.

December 28.

CHILDERMAS, HOLY INNOCENTS.—A day which is reputed unlucky for all purposes, whether marriage, paring one's nails, wearing a new suit, or beginning to do anything, the explanation being that it was the day on which the massacre of the Innocents by Herod took place. The ceremony of the boy bishop sometimes took place on this day as well as that of St. Nicholas, or his jurisdiction might last until this date. In order that the day might remain fresh in memory, children were whipped on this day—a method which may be compared with that of bumping a boy's head on a stone in beating the bounds. In France it was the privilege of the young people who rose early to turn over and smack the late risers as they lay in bed. In Wales on St. Stephen's Day any one was privileged to beat another on the legs, even until the blood ran. The custom may be compared with the practice of whipping boys in Spartan religious ritual.

Societies and Academies.

LONDON.

Physical Society, Nov. 9.—**J. B. Seth, Chetan Anand, and Gian Chand**: The effect of moist air on the resistance of pencil lines. The resistance of a pencil line increases when it is kept in a moist atmosphere. This change may, in certain circumstances, be utilised to measure humidity.—**L. F. Richardson, V. Stanyon**, and other students of Westminster Training College. An absolute current-balance having a simple approximate theory. A simple form of current-balance has been constructed which measures currents with a probable error of about 1 part in 1000. The coils are single layers, so that they can in the future be made as precise helices. The authors had to aim at cheapness rather than at perfection, and so irregularities of shape leave the current uncertain by 5 parts in 1000. A second approximation, depending on a simple deduction from Laplace's equation, corrects the elementary theory by 1·4 parts in 1000 of current. —**E. V. Appleton**: Notes on wireless methods of investigating the electrical structure of the upper atmosphere (I.). Various direct wireless methods of measuring the 'effective' height of the atmospheric ionised layer are discussed and compared. For a layer of horizontal stratification, and under conditions for which the influence of the earth's magnetic field may be neglected, the effective height is greater than the maximum height reached by the atmospheric ray.

Geological Society, Nov. 21.—**Frederick William Shotton**: The geology of the country around Kenilworth (Warwickshire). This paper completes the mapping of the so-called 'Permian' rocks at the southern termination of the Warwickshire coalfield. The strata are conformable with the carboniferous deposits on the north, and must therefore be regarded as belonging to that system. The total thickness of post-Keele carboniferous beds is estimated at about 3500 feet, with the top of the sequence overlapped unconformably by Keuper sandstone. Various subdivisions are made, the most important being a well-developed conglomerate (Gibbet Hill Conglomerate) above the Tile Hill Marl Group, and two breccia-bands at Kenilworth. The superficial deposits of the area have been mapped for the first time. They are divisible into an eastern and a western type.—**Stanley Smith and Sidney Hugh Reynolds**: The carboniferous section at Cattybrook, near Bristol. About 5 miles north of Bristol the carboniferous limestone rim of the Bristol coalfield is traversed by the South Wales branch of the Great Western Railway, by means of the Patchway Tunnel. In the railway-cuttings west of that tunnel, and in the adjacent brickworks, the rocks represented are the uppermost part of the carboniferous limestone (D_2 and probably D_1) and the coal measures. Red, coarsely oolitic, and current-bedded limestones, which often pass rapidly into grits, are the most characteristic rocks. The limestones contain much iron. At the western end of the main cutting the D_1 beds and coal measures are brought into contact by the Cattybrook Fault, and on both sides of this for some 200 yards the rocks show an astonishing amount of disturbance. East of the fault the D_1 beds are traversed by a powerful line of thrust. West of the fault the ironstone-bands in the coal measures may be crumpled up, or torn apart so as to resemble a series of isolated nodules.

Society of Public Analysts, Dec. 5.—**A. Scott Dodd**: The occurrence and determination of boron compounds in vegetable products. The amount of boron compounds (expressed as boric acid) found in dried raisins and currants ranged from 110 to 260 parts per million, and in miscellaneous dried fruits from 40 parts per million in prunes to 300 parts per million in apricots and peaches. In fresh fruits the quantities varied from 31 to 62 parts per million, corresponding to 280 to 550 parts per million on the dry substance.—**John Evans and A. O. Jones**: Chemical tests for drunkenness: the determination of small quantities of alcohol in urine. The urine is evaporated in a current of air, and the mixture of air and alcohol vapour led into a strongly acid standard solution of potassium dichromate. The alcohol is oxidised to acetic acid, and the unreduced dichromate is determined by adding potassium iodide and titrating the liberated iodine with standard thiosulphate solution. —**C. A. Adams and J. R. Nicholls**: The analysis of mixtures containing acetone, ethyl alcohol, and isopropyl alcohol. Tables have been made of the specific gravities and refractometer readings of aqueous mixtures of acetone and the lower alcohols; these tables can be used for calculating the proportion of three of these ingredients, provided that one of the three can be determined by an independent method.

Linnean Society, Dec. 13.—**S. L. Hora**: Evolution, divergent and convergent. Variations in organisms are the result of divergence. Convergence implies resemblances which result from independent functional adaptation to similar ends. Animals living under different conditions sometimes exhibit similar modifications; but these are responses to similar factors in the environments. Attention is also directed to the communal convergence, with special reference to the body-form, of insects inhabiting torrents. Organisms living in the same environment and in response to the same element in the habitat are sometimes differently modified. Environment is the supreme master of most of the changes in animal organisation, and organic evolution is an index of the varied conditions under which life exists.

DUBLIN.

Royal Irish Academy, Nov. 30.—**J. Algar and P. J. Hanlon**: Dichalkones derived from diacetoresorcinol. The dichalkones described are obtained by the condensation of furfuraldehyde and of *p*-dimethylaminobenzaldehyde with diacetoresorcinol. Furfuraldehyde in the presence of boiling alcoholic sodium hydroxide yields golden-yellow plates of difurfurylidenediacetoresorcinol (M.P. 226°-227° C.). Diacetoresorcinol condenses with *p*-dimethylaminobenzaldehyde in absolute alcoholic solution, in the presence of a small amount of piperidine, to form *a*-di-*p*-dimethylaminobenzylidenediacetoresorcinol—bright-red prisms, M.P. 240°-241° C. When 80 per cent alcohol is employed as solvent, an isomeric *β*-compound is obtained—orange-red plates, M.P. 262°-263° C. Attempts to convert the dichalkones into diflavone or dicoumaranone derivatives were unsuccessful.—**J. Algar and Nora M. MacDonnell**: The condensation of aldehydes with nitro-diacetoresorcinol. Nitrodiacetoresorcinol (M.P. 235·5° C.) is formed when diacetoresorcinol is treated at a low temperature with a slight excess of nitric acid in the presence of sulphuric acid. The nitro compound, when reduced by ferrous hydroxide, gives a small yield of aminodiacetoresorcinol (pale-yellow prisms, M.P. 185° C.). It condenses in the normal way with benzaldehyde and furfuraldehyde to form dichalkones; with piperonal the condensation proceeds in a somewhat unusual way, with the production of orange-red prisms (M.P. 262° C.). This substance does not give any of the usual reactions of dichalkones and would appear to be nitro-di-3′-4′-methylenedioxy-diflavanone.

EDINBURGH.

Royal Society, Dec. 3.—**T. A. Stephenson**: A contribution to Actinian morphology: the genera *Phellia* and *Sagartia*. In 1858, P. H. Gosse collected from a "rock called Proudfoot, at the entrance to Wick Bay in Caithness" (Gosse, 1860) the original specimens of *Phellia gausapata* Gosse. The author visited this rock in 1926 and collected thirteen examples of the species. The type-species of the genus *Phellia* was *P. murocincta*, but this has proved to be a form of *Sagartia troglodytes*, so *P. gausapata* now becomes the type-species. The genus *Phellia* is defined.—**Miss S. M. Manton**: On some points in the anatomy and habits of the Lophogastrid Crustacea. The Lophogastridæ are the most primitive living Malacostraca. They show a simpler filter feeding mechanism than that of any other known form in that in *Gnathophausia* a maxillary filtering mechanism exists alone. Further primitive characters are seen in the form of the mandible and in the segmentation of the abdomen. The mandibles show a simpler condition than yet recognised in any Peracaridan. A seventh abdominal segment is present in the abdomen as in the embryo of *Hemimysis*, but here it is incompletely fused to the sixth segment even in the adult. With the exception of *Nebalia* these are the only living forms with the seventh segment incompletely fused to the sixth. *Lophogaster typicus*, unlike *Gnathophausia*, is a specialised form which feeds on large food on the bottom. It has lost its filtering mechanism, and the structural changes involved resemble those of the members of the more specialised groups of the higher Peracarida which have given up filter feeding.—**H. G. Cannon** and **Miss S. M. Manton**: On the feeding mechanism of the Syncarid Crustacea. The Syncarid Crustacea, *Paranaspides* and *Anaspides*, both possess two distinct feeding mechanisms, one filtratory, by which minute suspended food particles are filtered from a food current, and the other raptatory, by which large food masses are seized by the mouth parts. In this respect they resemble *Hemimysis*, and it is suggested that the modern Malacostraca evolved from a form possessing these two mechanisms. The mouth parts of *Koonunga* show no evidence of a filtratory mechanism. The filter plate of the maxilla is represented by a group of stout spines. *Koonunga* is entirely a raptatory feeder.—**B. P. Weisner** and **F. A. E. Crew**: The preparation of p factors: their physiological action upon the immature, mature, and senile gonad. There are two phases of ovarian activity—the first (during which ovulation occurs and œstrin is produced) is caused by a factor, p_1; the second (during which œstrin and also betahormone is produced, so that pregnancy or pseudo-pregnancy occurs) is induced by another factor, p_2. p_2 is also produced in the (human) placenta. Extracts of p_2 from placenta prolong the second phase, induce the formation of active corpora lutea, etc. When administered to animals, the ovaries of which do not contain active lutein cells or corpora lutea which still can be activated, the extracts cause œstrus until sufficient lutein tissue has been formed. They have a very intensive reactivating influence upon the senile male gonad. There has also been observed a favourable influence upon the general state of the animals. These extracts are protein-free and non-toxic and can be given to human beings. (See NATURE, Mar. 31, p. 498.)

PARIS.

Academy of Sciences, Nov. 12.—**A. Lacroix**: The constitution of the lavas of the island of Mehetia (Society Archipelago). Complete chemical analyses of six specimens, ranging in composition from an ankaratitic limburgite to a Labrador basalt.—**J. Costantin**: Appearance of argonanes on the field eryngo (*Eryngium maritimum*) in the laboratory.—**Charles Richet, Mlle. Eudoxie Bachrach**, and **H. Cardot**: The adaptation of marine animals to living out of water. The experiments were carried out with crustaceans and with fish (*Gobius*), each being taken out of the water for gradually increasing periods. The crustaceans acquired the power of remaining out of water a certain time without injury. The three species of *Gobius* also acquired an increased resistance to exposure to air.—**A. Bigot**: The existence of medusæ in the Bajocian of Bessin.—**Blas Cabrera y Felipe** was elected *Correspondant* for the Section of Physics in succession to the late S. Arrhenius.—**C. Lurquin**: A fundamental inequality of probability.—**F. Eggenberger** and **G. Pólya**: The interpretation of certain curves of frequency.—**Bertrand Gambier**: The intrinsic equation of a surface.—**Jacques Chokhate**: The best approximation of measurable and limited functions with the aid of polynomials or limited trigonometrical series.—**K. Kunagui**: An infinite number of dimensions lower than that of the space of Hilbert.—**Eugène Slutsky**: Continued contingent functions, integrable and capable of differentiation in the stochastic sense.—**Raphaël Salem**: A general property of Fourier coefficients of functions capable of summation.—**Alex. Froda**: The zeros of integral functions.—**Armand de Gramont** and **Georges Mabboux**: The soundness of spherical levels with bubble.—**F. Bourion** and **Mlle. O. Hun**: The magnetism of hydrated zirconia. The magnetic susceptibility was proved to be a linear function of the proportion of water present. Hence, from the magnetic point of view, hydrated zirconia behaves as a mixture of water with a feebly paramagnetic hypothetical zirconium oxide, ZrO_2.—**R. de Mallemann**: The expression of the refractive power.—**A. Travers** and **Malaprade**: The existence of a new kind of fluoborates. Additional evidence is given of the existence of a new form of fluoboric acid, characterised by the fact that its potassium salt is soluble.—**Dumanois** and **Mondain-Monval**: Remarks on the oxidation of hydrocarbons. An account of the study of the oxidation by air, under pressure, of pentane at temperatures between 0° C. and 300° C., both with and without lead tetra-ethyl.—**Frérejacque**: The configuration of the trivalent nitrogen atom. The physical properties of a series of substituted amides derived from a new camphor sulphonic acid are given: the conclusion is drawn that there is no experimental reason to suppose that the three valencies of nitrogen are not in the same plane.—**J. Cuvillier**: The Nummulites in the Eocene in the neighbourhood of Cairo.—**J. Thoulet**: The cycle of the oceanic limestone.—**Pierre Dangeard**: Iodine volatilisation and its characters in the northern algæ. The evolution of iodine, first proved for French algæ, has also been proved for plants growing in the Arctic regions, and hence is not a phenomenon closely subordinated to the conditions of the medium of growth, as might have been expected.—**Pierre Lesage**: The comparative growth at Rothamsted of plants cultivated at Rennes, which have originated from seeds ripened at very different latitudes. A single generation of life at the Midi, Algiers, or at Marseilles is not sufficient to determine precocity in the north, at Rennes or at Rothamsted.—**V. Hasenfratz**: A principle extracted from *Sphacele parviflora*. From the microanalysis and characters of the small quantity of material isolated (0·7 gram) it is concluded that the substance is identical with ledol, or Ledum camphor, extracted by Grassmann in 1831 from *Ledum palustre*.—**Lucien Daniel**: The influence of grafting

on the reproductive correlations.—P. Lazareff: The action of alcohol on the adaptation of the eye in the course of peripheral vision.—A. V. Léontowitch: The microstructure of the nervous system (of its neurones) as a basis for the theories of conductivity and stimulation in the nervous system.—Ludovic and Pierre Blaizot: *Treponema podovis*, the pathogenic agent in the foot disease (*piétin*) of sheep. A new spirochæte has been isolated which is regarded as the true cause of the disease. Treatment of infected animals with atoxyl and with novoarsenobenzol proved that the best results were obtained with the latter substance, although in grave cases a relapse occurred after 10–15 days. It is probable that a prolonged arsenical treatment will be necessary for a complete cure.

Nov. 19.—Jean Perrin: The determination of the rôle of light in thermal chemical reactions.—Charles Moureu, Charles Dufraisse, and Marius Badoche: Autoxidation and antioxygen action. The catalytic action of arsenic and its compounds. A summary of the results obtained with twenty-two substances containing arsenic. In general, organic compounds of arsenic containing oxygen are much less active as catalysts than inorganic arsenic compounds.—A. Blondel: Remarks on the theory of oscillographs and recording apparatus.—André Roussel: The primitive of the second species.—J. Priwaloff: A general property of analytical functions.—Josef Miculáš Mohr: The determination of the apex by means of *G*-type stars.—N. Stoyko: The approximate calculation of the influence of the short period terms in the determination of time by the meridian telescope.—René Planiol: A very slightly damped pendulum. Some results obtained with a torsion pendulum (quartz fibre suspension) placed in a high vacuum.—Marcel Chopin: Control of a new method of measurement of the temperature of gases.—N. Bogoliouboff and N. Kryloff: The mathematical theory of oscillographs.—Pierre Daure: The secondary radiations observed in the molecular diffusion of light (Raman effect). A study of the effect produced with the halogen derivatives of phosphorus, arsenic, antimony, bismuth, carbon, silicon, and tin. The Raman spectra of all these elements consist of four chief lines, the characteristic frequencies of which decrease regularly with the atomic weight, but no simple law has been found to express this.—Ponte and Y. Rocard: The possible rôle of diffusion by electrons in the propagation of short waves.—Jacques Risler and Foveau de Courmelles: The action of light rays on potassium chloride. The action of potassium chloride on a photographic plate is increased if the salt has been previously exposed to light. The effect is most marked when the activation has been caused by exposure to ultra-violet light.—Charles Prévost: The action of β-ethylallyl bromide on ethylmagnesium bromide. Two isomeric hydrocarbons are produced in this reaction,

$$EtCH=CH-CH_2Et \text{ and } CH_2=CH-CHEt_2.$$

—Stanislas Landa: The slow combustion of triacontane. Normal triacontane, $C_{30}H_{62}$, slowly oxidised with air, gave fatty acids, including butyric and valeric, and a mixture of aldehydes. Neither ketones nor alcohols could be detected among the oxidation products.—Raymond Delaby and Pierre Dubois: The formation of allyl alcohol. The pyrolysis of the formins of glycerol.—Raymond Furon: The fossil delta of the Sahelian Niger.—E. Guyénot and A. Naville: The chromatic reduction in *Drosophila melanogaster* and the theory of crossing over.—D. Bach: The conditions of action of asparaginase from *Aspergillus niger*.—Albert Leulier, Léon Velluz, and Henri Griffon: The distribution of potassium in the animal organism. There are distinct differences in the amounts of potassium present in the different forms of muscular tissue.—A. Boquet: The adsorption of cobra poison and of the diphtheria toxin by carbon. Finely divided carbon (norit) renders cobra poison innocuous; diphtheria toxin is also rapidly adsorbed by carbon and its toxic power removed.

Official Publications Received.

BRITISH.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19, N.S., Nos. 9-13. 9: A Synthesis of 5:7:2':4'-Tetrahydroxylflavone and of 7:2':4':6'-Tetrahydroxylflavone, by Dr. Nicholas Michael Cullinane, Dr. Joseph Algar and Dr. Hugh Ryan; 10: The Estimation of Diphenylamine and Diphenylnitrosamine in the Presence of their Derivatives, by Dr. H. Ryan, Dr. J. Keane and J. Dunne; 11: The Action of Aromatic Amines on Nitric Esters, by Dr. Hugh Ryan and Michael T. Casey; 12: The Commercial Utilisation of Java Citronella Oil, by Dr. Brendan O'Donoghue, James Drum and Dr. Hugh Ryan; 13: The Action of Alcoholic Hydrochloric Acid on Methyldiphenyltetrahydropyrone, by Dr. Hugh Ryan and Dr. J. J. Lennon. Pp. 77-124. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 4s.

Proceedings of the Royal Society of Edinburgh. Vol. 48, Part 3, No. 15: The Invariant Theory of the Quaternary Quadratic Complex. 2: The Complete System. By Prof. H. W. Turnbull and Dr. J. Williamson. Pp. 180-190. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1s.

Transactions and Proceedings of the New Zealand Institute. Vol. 59, Part 2, June. Pp. iv+218-428+plates 34-67. (Wellington, N.Z.) 10s.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1154 (Ae. 319): Wind Tunnel Experiments on a Model Autogyro at small Angles of Incidence. By C. N. H. Lock and H. C. H. Townend. Pp. 61+20 plates. (London: H.M. Stationery Office). 2s. 6d. net.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-second Session adopted at the Annual Meeting of Governors held on the 16th October 1928. Pp. 71. (Glasgow.)

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1927-28. Vol. 72. Pp. 219+ii. (Manchester.) 12s.

FOREIGN.

Japanese Journal of Botany: Transactions and Abstracts. Vol. 4, No. 2. Pp. iv+118-217+31-54+plates 16-22. (Tokyo: National Research Council of Japan.)

Records of Oceanographic Work in Japan. Compiled by the Committee on Pacific Oceanography of the National Research Council of Japan. Vol. 1, No. 2, October. Pp. ii+57-94+plates 16-23. (Tokyo: National Research Council of Japan.)

Verhandlungen der ozeanographischen Konferenz veranstaltet von der Gesellschaft für Erdkunde zu Berlin anlasslich ihrer Hundertjahrfeier 24-26 Mai 1928. Mit Unterstützung der Notgemeinschaft und im Auftrage des Vorstandes. Herausgegeben von A. Defant. (Ergänzungsheft 3 zur *Zeitschrift der Gesellschaft für Erdkunde zu Berlin.*) Pp. xiv+157. (Berlin: Gesellschaft für Erdkunde.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 26, Part 3: Costa Rican Mosses collected by Paul C. Standley in 1924-26. By Edwin B. Bartram. Pp. vi+51-114+vii-x. (Washington, D.C.: Government Printing Office). 20 cents.

Proceedings of the United States National Museum. Vol. 74, Art. 2: Three new Species of Two-winged Flies of the Family Bombyliidae from India. By J. M. Aldrich. (No. 2747.) Pp. 3. Vol. 74, Art. 17: New Fresh-water and Marine Bivalve Shells from Brazil and Uruguay. By William B. Marshall. (No. 2762.) Pp. 7+4 plates. (Washington, D.C.: Government Printing Office.)

University of Illinois Engineering Experiment Station. Bulletin No. 183: Tests of the Fatigue Strength of Steam Turbine Blade Shapes. A Report of an Investigation conducted by the Engineering Experiment Station in co-operation with the Allis-Chalmers Manufacturing Co. By Prof. Herbert F. Moore, Stuart W. Lyon and Norville J. Alleman. Pp. 38+2 plates. 20 cents. Bulletin No. 184: The Measurement of Air Quantities and Energy Losses in Mine Entries, Part 3. By Alfred C. Callen and Cloyde M. Smith. Pp. 61. 35 cents. (Urbana, Ill.)

Diary of Societies.

FRIDAY, DECEMBER 21.

EMPIRE SOCIETY (at Hotel Victoria), at 3.—P. Edmonds: Burma and the Burmese.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.—C. H. Hudson: Oils for Cutting and Quenching Purposes.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—J. E. Tapper: Hire and Hire Purchase in Electrical

THURSDAY, DECEMBER 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Wood: Sound Waves and their Uses (I.): Waves.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Wood: Sound Waves and their Uses (II.): Signalling in Air and Water.

SATURDAY, DECEMBER 29, 1928.

CONTENTS.

Population Problems.

IT would seem that the daily press is beginning to regard the facts and figures issued periodically by the Registrar-General as good copy. In any event, increasing prominence is given to them, and headlines direct our attention to a further fall in the birth-rate. But comment is withheld ; the fall is not applauded. Presumably it is supposed that national prestige and numbers are somehow linked together, and that therefore a diminution in the number of Englishmen in the next generation cannot be a matter for congratulation. On the other hand, the fall is not bemoaned. We all know that there are more than a million unemployed. It is worth remarking that in pre-War days we knew only the percentage of the unemployed among a very small proportion of the wage earners. For a short time in 1857, 1879, and 1886, more than 10 per cent of them were unemployed, while the normal figure was nearer 5 per cent. But 10 per cent may not sound alarming. There are at present more than 11 per cent unemployed, and, if we still thought in percentages instead of in totals, the employment position would not seem so bad and the fall in the birth-rate might be a matter for unfavourable comment. (This should not be read as implying that the seriousness of the unemployment phenomenon is exaggerated ; but it is its chronic nature rather than its amount which is unexampled.) We are now growing accustomed even to these huge figures, and there is perhaps some reason to think that we are on the verge of plunging into a population panic and are held back only by our realisation of the magnitude of unemployment. One day a further fall in the birth-rate may be greeted by panic headlines in the press. Meanwhile, the position seems to be that unemployment is functioning as an anæsthetic while birth control gains firmer hold.

Alarm is likely to be aroused when it is realised that the natural increase, or annual increment to the population by excess of births over deaths, will, things remaining as they are, rapidly diminish in the near future. Assuming things to remain as they were a few years ago, Prof. Bowley made certain estimates which, while well known to students, have not as yet become very familiar to the public. Assuming the annual number of births to remain as in 1921–23, the death-rate to remain as in 1910–12, and that there was no migration, he calculated that the population of Great Britain, which was about $42\frac{3}{4}$ millions in 1921, would reach about $45\frac{1}{3}$ millions in 1931, $47\frac{1}{4}$ in 1941, and $48\frac{1}{4}$ in

1951, after which it would remain approximately table. But things are not remaining as they were. The number of births in Great Britain was 895,209 in 1922, 870,033 in 1923, 836,833 in 1924, 814,719 in 1925, 797,347 in 1926, and 751,638 in 1927. The birth-rate, in fact, falls year by year. It was 16·6 per 1000 living at all ages in 1927, this being the lowest rate ever recorded. It is a remarkable fact that the number of births registered in 1927 was the lowest registered since 1855, although at the earlier date the population was less than half its present size.

During the same years there has been a considerable loss by emigration. The net loss by emigration to countries out of Europe from Great Britain and Northern Ireland was 91,262 in 1924, 84,259 in 1925, 115,53[illegible] in 1926, and 75,444 in 1927. The inference is obvious. Stabilisation of population will come sooner than was to be anticipated a few years ago. It might even be the case that, if Prof. Bowley's calculation were repeated, and the estimate of the annual number of births amended to compare with the present position, the result might show that a decline in the population is to be expected before many years have passed, even if the effect of migration is left out of account. Such a calculation, it may be remarked, is possible only with a census year as a basis, because it is only for a census year that we have the necessary information regarding the age distribution of the population.

The natural increase of the population is thus becoming less year by year. The excess of births over deaths in England and Wales was about 242,000 in 1926 and about 169,000 in 1927. At the same time migration is removing many thousands every year. However much our exporting industries may languish, we remain great exporters of men. A list of European countries arranged according to intensity of loss of population consequent upon overseas migration per 100,000 inhabitants from 1920 to 1924 shows the first five countries to be as follows: Irish Free State 425, Great Britain and Northern Ireland 327, Italy 274, Portugal 227, and Spain 206. We are in this respect associated with a group of countries with whom we do not commonly class ourselves. Owing to the combined effects of diminishing natural increase and loss by migration, the estimated populations of Scotland, Ireland, and the Irish Free State fell by some thousands each between mid-1926 and mid-1927. In England and Wales alone out of the four constituent areas of these islands did the estimated total in mid-1927 show an advance upon that for mid-1926. But it will not be long before the position in England and Wales approximates to that in the other three areas.

However much opinions may differ in other respects, there will be universal agreement about one factor in the situation—the death-rate. We shall continue to agree to attempt to reduce it. It is migration and the birth-rate which present problems. Should we encourage migration? Should we welcome a further fall in the birth-rate? Migration is a troublesome problem. It is advocated for two somewhat different objects. At times the primary object is said to be the relief of congestion at home. At other times emphasis is laid on the fact that, while population is dense in England, it is sparse in the dominions, and that migration would bring about a desirable redistribution of population within the Empire.

The facts themselves are none too clear. We know something about movement to non-European countries from Great Britain and Northern Ireland and from the Irish Free State respectively, but we know little about movement within these islands. Figures compiled by the Irish Free State Department of Industry and Commerce show that in 1927 there was an outward balance from the Free State of 20,688 persons in the traffic between that country and the remainder of the British Isles. Of this total, about 30 per cent was accounted for by migrants from the Irish Free State who travelled to non-European countries via British ports. It seems to follow that an addition of some 14,000 was made to the population of Great Britain and Northern Ireland during 1927 by emigrants from the Free State.

During the same period some 63,000 persons were assisted to emigrate from Great Britain under the Empire Settlement Act of 1922. Emigration is costly. Under this Act, up to three millions may be spent annually from national funds in support of approved emigration schemes, provided that at least half the cost of each scheme is met by some other authority, public or private. But this is by no means all, or even the greater part of the expense. There are government schemes for training men for emigration under the Ministry of Labour; there are numerous private agencies at work. Looking further back, there is all the expense of bringing up and educating men who, when of age to produce, are shipped off to another country.

One aspect of the present policy seems indefensible. If the object is to relieve congestion in Great Britain, it is foolish to allow the places of those assisted to depart to be filled by immigrants

from Ireland. Why not, it might be said, also raise a cry against the influx of Scotsmen into England? Is this not pure prejudice? The answer is that it is not a question of race at all but a question of finance. Scotland shares with England the expense of emigration. The Irish Free State does not. If it is said that the object is not primarily the relief of congestion at home, but the redistribution of population throughout the British Empire, then with equal force it may be urged that the financial burden is unfairly distributed, and that direct emigration of the Irish to the Dominions would be a less circuitous method than sending Englishmen from home and replacing them in part by Irishmen.

This matter, though not unimportant, is a side issue. A discussion of the main issue, however, raises so many matters of such complexity and obscurity that it is not possible to do more than indulge in vague generalisations. It must be remembered that a further decline in the birth-rate in Great Britain will not affect the employment position until fourteen years have passed. With the birth-rate at its present level, it is possible that the population will be stable, or at least not increasing, fourteen years from now. It does not seem unreasonable to hope that within that period we can get our population employed up to the pre-War level. With such facts and anticipations in mind, it would seem that the fall in the birth-rate of Great Britain has gone far enough. A restricted policy of assisted emigration for the next few years, provided that reasonable safeguards are provided to meet the difficulties mentioned above, seems reasonable, both because we are still faced with an annual increment of population in Great Britain for a few years, which we can scarcely be said to require, and because the sparsely populated Dominions are apparently capable of absorbing these emigrants at the present rate.

This does not mean, however, that it would be satisfactory if the birth-rate remained as it is in all respects. The birth-rate is an average figure for the population. The rate is lower than this figure among the comfortably situated, and highest among the least comfortably situated—the miners, for example. It is a curious fact that anyone who deplores this well-known phenomenon is assumed to do so wholly on the grounds that the stocks, with the most valuable biological endowments, are not reproducing themselves as they should. But whether this is so or not, we might surely all join in deploring it on the obvious grounds that those parents who by reason of their financial position are best able to provide children with a good upbringing and a decent education have the smallest families. Such information as we possess for Great Britain—and it is very scanty—does not tend to show that the contrast between the well-off and the badly-off in respect to size of family is growing less. There is evidence, however, from Sweden, and also from Holland and Germany, that in late years this gap has been closing. In Stockholm it is now apparently the case that the better-off parents have the most children, whereas not many years ago the situation was much as in Great Britain. There could scarcely be any investigation more profitable than one which would throw light upon the causes of so remarkable a change. It might then be possible to attempt to bring influences to bear which would lead to a similar change in Great Britain.

A. M. C.-S.

Natural History and Literature.

(1) *Birds and Beasts of the Greek Anthology.* By Norman Douglas. Pp. vii + 215. (London: Chapman and Hall, Ltd., 1928.) 7*s.* 6*d.* net.

(2) *Nature in the Age of Louis XIV.* By Phyllis E. Crump. Pp. xv + 224. (London: George Routledge and Sons, Ltd., 1928.) 10*s.* 6*d.* net.

(3) *Tableau de Lilliput ou Essai sur les Infusoires.* Par Marcel Roland. (Collection de *La Grande Revue.*) Pp. 51. (Paris: Les éditions Rieder, 1928.) 6 francs.

(1) MR. NORMAN DOUGLAS has found in the famous collection of poems known as the Greek Anthology about six hundred references to wild animals, and to about a hundred and fifty different kinds. He discusses many examples in his scholarly way and with a pleasant wit; and his book is of interest in its disclosure of the mood in which many different minds looked at familiar animals through the long stretch of time which the Anthology covers. There are references to lions and lynxes, bears and boars, wolves and goats, but most of them are so trivial that we welcome the long-standing puzzle of the unicorn. Birds are happily represented by the eagle, the raven, the crow, and many others, but rarely with any insight, so far as we can discover from the quotations; and we are glad to come to the long-lived phœnix and the elusive halcyon. The interest is often not so much that of natural history or of poetry, but the 'akanthologous' fascination of thorny questions. Reptiles are represented by adders and asps, geckos and crocodiles; and amphibians by the vocal tree-toad or ololygon

and the common frog—"the muse of damp retreat."

Fishes seem to have been treated somewhat cursorily, but there is again the agreeable riddle of identification,—of the most self-contradictory skaros, for example, or the beauty-fish, kallichthys. There is mention of conger and red mullet, of sprat and shark, of mackerel and tunny; and if we include the dolphin among fishes, we may also mention the argonaut. The humbler creatures of the sea are occasionally referred to—the *Murex* yielding purple (and yet no mention of pearls or coral); the "crook-legged sand-diving crab, with two-clawed gear," the hermit-crab "that can never be made to walk straight"; and so on down to sponges, somewhat enthusiastically called "the blossoms of the sea." About a fifth of the references are to insects, such as ants, bees, and wasps. Mr. Norman Douglas has given much time to his labour of love, and we do not know how it could have been done better. Yet there is no blinking the fact that, good poets as many of the Greeks of the Anthology were, they are not seen at their best in their natural history references, which are too often trivial and prosaic. As regards both the natural history and the poetry, Mr. Douglas could have done much better himself; but of course that was not what he set out to do.

(2) Miss Crump's scholarly study of the attitude to Nature in the seventeenth century shows that this was more positive than has been hitherto believed. Apart from the fables of La Fontaine and the expressions of the pastoral ideal in the first thirty years of the century, it has been generally stated that there was no appreciation of Nature in France in the seventeenth century; and this has been explained as due to the non-existence of the theme in the Middle Ages and sixteenth century, and to the consequent lack of traditional foundation; to the prevalence of the mechanical view of Nature held by Descartes; to the fact that the feeling for Nature repressed in literature, for reasons of custom and fashion, found its compensatory outlet in pictorial art; and, finally, to the monotony of the landscape around Paris! These ingenious reasons, as Miss Crump shows, were invented to explain a phenomenon which does not really exist, for it is not true that there was an absence of a feeling for Nature in France in the age of Louis XIV.

The author marshals her evidence in a pleasant and convincing way, beginning with the enthusiasm for gardening—sometimes emancipated gardening—in the seventeenth century. She goes on to the evidence of a growing love of the country and to the expression of the pastoral ideal in drama and romance, eclogue and idyll. There is an appreciable development of a sense of the picturesque and a detectable tightening of the cords binding man to Nature. In not a few seventeenth-century writers there is a somewhat sophisticated emphasis on the charm of solitude and the value of a retreat from the Parisian world; but there is little indication of anything like an overwhelming love of the country. Something of this emerges clearly, however, in Madame de Sévigné and in La Fontaine, but they were outstanding exceptions. The author leaves us with the general impression that the love of Nature during the Louis XIV. period was still incipient, more than a little cold and conventional, somewhat distant and indicative of shallow acquaintanceship.

We wish the learned author had said something in regard to the influence of the re-awakening natural science which was beginning to disclose something of the veritable and verifiable wonder of the world. For one cannot have much depth of feeling towards an object in regard to which one had had no depth of experience. As regards man and animate Nature, it may be said that he loveth best who knoweth most.

(3) With these solid essays by two learned scholars we have deliberately linked a gossamer essay by Marcel Roland on the Lilliputian world of a drop of muddy water. What the scholars, in spite of their infective enthusiasms for their subjects, seem to us to have been forced to show (perhaps we are wrong) is the general poverty, triviality, and wooden conventionality of natural history allusions in literature when these have not behind them a well-informed sympathy. There are occasional poetic flashes among the natural history references in the Greek Anthology, and no one can doubt the insight of La Fontaine, but on the whole the Greeks and the French literateurs of the periods referred to do not distinguish themselves in their natural history allusions. Contrast with that the real thing, the reflections of an amateur naturalist, disciplined yet not too well up in his subject, a romanticist yet a devotee of the microscope as a window in the invisible. For Marce Roland tells us, in a characteristically moder mingling of science, poetry, and philosophy, of th ongoings he has watched in the Lilliputian worl of his drop of water.

The science of the muddy drop, with its tenantr; of bacteria, infusorians, amœbæ, and so forth has often been better done, yet the naturalist i

dull who cannot find suggestions in Roland's romantic reflections. The philosophy of the initiatives in living observable in the muddy drop,—the reactions and urges, the tropisms and experiments, now appearing so mechanistically describable and again so vitalistically apart, has been better done; yet how few philosophers ever deign to mention these infant school beginnings, and how few write of organisms as if they had ever watched any. Contrasted with what we find in Greek Anthology and Louis Quatorze literature, *as regards Nature,* we have here a delightful artistic expression. Roland knows his muddy drop, though we think he might know it better still; he is sympathetically intrigued by the behaviour of his Lilliputians; he strikes the modern note in his persuasion that they and he belong to the same kingdom; he takes them seriously enough to get to know their ways and look out for their intimations of immortality and love, of endeavour and sociality. Not unnaturally, the result is a very enjoyable work of art.

Scientific Societies in the Seventeenth Century.

The Rôle of Scientific Societies in the Seventeenth Century. By Martha Ornstein. Pp. xiv + 308. (Chicago: University of Chicago Press; London: Cambridge University Press, 1928.) 15*s.* net.

MARTHA ORNSTEIN was born in Vienna in 1878, and received her early education there. She went to the United States in 1895, and, after a year spent in perfecting her English, she passed the entrance examination at Barnard College with distinction in 1896. After taking her Master's degree in 1900, she specialised in mathematics for some years; then, turning to historical study, she wrote as her dissertation for the Ph.D. degree (conferred on her in 1913) the work now under review, which has been republished by her friends as a tribute to her memory. It was worth while, for the book is a sound piece of work, well written (with scarcely a trace of a 'foreign accent') and well documented, and one which, within its compass, it would be difficult to improve upon. The prodigious amount of labour entailed can be judged by reference to the copious footnotes and to the bibliography at the end, covering no less than thirteen pages. The book is beautifully printed, and presents its fascinating story in a form which also delights the eye. We can only wish the publication the success which it richly deserves.

The writer observes that if the progress of a century is shown by a comparison of the state of knowledge which existed, say, in the first and last decades, no other century, perhaps, can show such an advance as the seventeenth. The essential task of the seventeenth century was the establishment of the experimental method in science, and, to appreciate the splendour of its achievements, it is sufficient to mention the names of such men as Galileo, Torricelli, Guericke, Robert Boyle, Harvey, Kepler, Pascal, Fermat, Descartes, Huygens, Leibniz, and Newton. We may draw a dividing line about the middle of the century. The first half accomplished through the work of a few men a revolution in the established methods of thought and inquiry; it created the experimental method, and produced its indispensable instruments, the telescope, the microscope, the air-pump, etc. The second half of the century saw the elaboration of the results obtained.

The first part of the book is devoted to individual pioneers such as Galileo, Torricelli, Harvey, Descartes. After a time the necessity of extending the scope, number, and elaboration of experiments involved expenditure in money and material beyond the resources of the private investigator, who then became dependent on the patronage of wealthy persons interested in science. Much service was rendered to science by wealthy amateurs, some of whom devoted their whole lives and resources to scientific research. There were in England, Robert Boyle, John Evelyn, Sir William Petty; in Ireland, William Molineux of Dublin, inventor of the hygroscope; in France, Peiresc; in Holland, Leeuwenhoek and van Helmont; in Germany, Guericke, Hevelius, and Tschirnhausen; in Italy, Ferdinand and Leopold dei Medici and Count Marsiglio. But the tendency quite early was for investigators to form themselves into groups, each contributing to the common stock, so that the benefit of intellectual co-operation was added to that accruing from the pooling of material resources. Hence the formation of the various societies which are the special subject of the book before us.

One of the very earliest of these societies was the Accademia dei Lincei in Rome (1600–30), founded by Fredrigo Cesi, which had for its device a lynx with upturned eyes tearing a Cerberus with its claws, and symbolising the struggle of scientific truth with ignorance. Della Porta, Peiresc, Galileo, and Fabius Colonna, the botanist, became members. Galileo was in very close relations with it, always referred to himself in the dialogues as Academicus, and added this title to his name in publishing his books. The "Gesta Lynceorum"

was the earliest recorded publication of scientific papers by any society. The first organised scientific academy was the Accademia del Cimento of Florence (1657–67), actually founded by the two Medici brothers Ferdinand II. and Leopold. Its leading spirits were the disciples of Galileo, Viviani, and Torricelli, and their pupils. The Italian societies form the subject of Chap. iii.; Chap. iv. gives the early history of the Royal Society of London, which arose out of informal meetings of scientific and learned men, first in London, then in Oxford (the "invisible College"), and then again in London, and received its charter as the "Royal Society" on July 15, 1662.

Chap. v. deals with the French Académie des Sciences, which also, like the Royal Society, arose out of informal meetings of scientific men. These meetings at first took place at the cell of the famous Minorite friar Morin Mersenne (1588–1648). Fermat, Roberval, Pascal, and Gassendi were among those who participated, entertaining themselves with astronomical observations, problems of analysis, physical experiments, new discoveries in anatomy and botany; they were often joined by foreign guests. Later they met every Thursday at various houses, including Pascal's, and later again at the home of Melchisedec Thévenot (1620–92). Colbert knew of their meetings, and proposed to Louis XIV. to give them an official status. The Académie des Sciences became, unlike the Royal Society, a government institution, and suffered the vicissitudes inseparable from direct government control. Until the death of Colbert (1683) it prospered; but under his successor, Louvois, it declined, as Louvois had no sympathy with pure science, and wanted to make the work of the Academy more practical. Chap. vi. deals with the German scientific societies.

Not the least interesting of the chapters is Chap. vii., on the scientific journals. Before the establishment of such journals, the only means of scientific intercommunication was private correspondence, for example, that of Mersenne, Peiresc, Collins, and Wallis. How unsatisfactory this medium was is proved by the numerous disputes about priority of discovery, for example, between Torricelli and Pascal, Hooke and Huygens, Newton and Leibniz. The way out of the difficulty was clearly indicated when Denis de Sallo published, on Jan. 5, 1665, the first number of the *Journal des Sçavans*. About two months later, on Mar. 6, 1665, appeared the first number of the *Philosophical Transactions of the Royal Society*; this was the first scientific periodical published under the auspices of a society which was destined to last to the present time. One or other of these two journals became the model for all later scientific periodicals.

Chap. viii., on science at the universities, makes melancholy reading, for the universities, clinging firmly to their old traditions, gave the cold shoulder to the new movement; indeed, they made little contribution to the progress of science in the seventeenth century, save in the faculties of medicine. Wallis left Cambridge for Oxford because the study of mathematics had died out at Cambridge! "It was," as the author says, "the unmistakable and magnificent achievement of the scientific societies of the seventeenth century, not only to put modern science on a solid foundation, but in good time to revolutionise the ideals and methods of the universities, and render them the friends and promoters of experimental science instead of the stubborn foes they had so long been." T. L. H.

Wave Mechanics.

(1) *Collected Papers on Wave Mechanics*. By Prof. E. Schrödinger. Translated from the second German edition. Pp. xiii + 146. (London and Glasgow: Blackie and Son, Ltd., 1928.) 25*s*. net.

(2) *Four Lectures on Wave Mechanics*: delivered at the Royal Institution, London, on 5th, 7th, 12th, and 14th March 1928. By Prof. Dr. Erwin Schrödinger. Pp. viii + 53. (London and Glasgow: Blackie and Son, Ltd., 1928.) 5*s*. net.

(3) *Selected Papers on Wave Mechanics*. By Louis de Broglie and Dr. Léon Brillouin. Authorised translation by Winifred M. Deans. Pp. vi + 151. (London and Glasgow: Blackie and Son, Ltd., 1928.) 15*s*. net.

IN the preface to the first of the above books, the author mentions a question asked him by a young woman friend: "When you began this work you had no idea that anything so clever would come out of it, had you?" This quotation certainly sums up the impression conveyed after reading (1). Schrödinger, however, uses it to bring out the point that in a set of papers in which a single theme is developed, the results of the later papers were more or less unknown when the earlier ones were written. This must be borne in mind when judging these collections.

During the short time of its separate existence, the new quantum mechanics has already branched out in several directions, two of the most important being roughly summed up as wave mechanics and matrix mechanics. As is shown both in (1) and (3), these two branches are mathematically reconcilable.

But from the point of view of the physicist who wishes to form some sort of mental picture of the processes involved, the wave mechanical method suggested to Schrödinger by the work of de Broglie has a direct appeal which the matrix method, simply because it stifles intuition, must fail to make. Moreover, in the wave mechanical method, the cardinal problem of atomic dynamics, the coupling between the dynamic process in the atom and the electromagnetic field is capable of a treatment in which the mechanical field scaler (ψ) enters into the unchanged Maxwell-Lorentz equations as the 'source' of the electromagnetic field vectors. In these works of de Broglie and Schrödinger we see the stages of the development of wave mechanics from the analogy pointed out by Hamilton between dynamics and optics, and how for the small scale dynamical system a mechanics founded on wave motion is just as necessary as is the wave theory of light in the case of small scale optical systems.

When we contrast the views of the two authors on the interpretation of micromechanical dynamics we at once meet a divergence. On Schrödinger's view we can no longer speak of a material particle describing a trajectory, yet, as de Broglie points out, an atom the dimensions of which are of the order 10^{-8} cm. can absorb a quantum of ultra-violet light (the photoelectric effect) the wave-length of which is more than 1000 times as great. From this it would seem that the region where the energy is localised must be a point even on the wave-length scale. To meet the difficulty, de Broglie has proposed the view that the material particle is an essential reality the motion of which is completely determined as that of a singularity in a propagated wave. By leaving the initial conditions arbitrary the ψ-wave can be regarded not only as a guiding wave by which the motion of the particle is controlled, but also as a probability wave which will give the probability of presence of the particle in a given element of volume when its initial position is unknown. This suggestion gives a glimpse of the way in which the continuous solutions of the wave equation can be applied to the admittedly atomic structure of matter and radiation. It would appear that the continuous solution provides a statistical view of phenomena the exact description of which would require waves possessing singularities. Here possibly lies a way of escape from the apparent indeterminateness of quantum mechanics.[1]

(1) This collection is particularly valuable, as it contains practically all the work of Schrödinger on wave mechanics published up to June 10, 1927. The style is clear and vigorous, but the too frequent use of italics rather spoils the effect. An abstract is given at the beginning in order to co-ordinate the nine papers which form the contents. Especially interesting is the author's treatment of the relation between his own work and that of Heisenberg, Born and Jordan.

(2) This contains the four lectures delivered by Schrödinger last March to a large and appreciative audience at the Royal Institution. A summary of these lectures has already been given in NATURE by the reviewer.[2] This little book of Schrödinger's is a small masterpiece of presentation, and gives a wonderfully clear idea of the present state of his work and what it has accomplished.

(3) The papers of de Broglie and Brillouin form a more heterogeneous collection. De Broglie has very definite views on physical interpretation, which are well brought out in his paper on the atomic structure of matter. A description of Kaluza's universe of five dimensions, in which the notion of force disappears entirely from mechanics, and is replaced by geometrical conceptions even in the case of a point charge moving in an electromagnetic field, forms one of the most interesting of the papers. Two of the three contributions of Brillouin deal with matrix mechanics and the application of statistical methods to quantum problems.

Taken as a whole, these three books form a valuable contribution to science. To be appreciated properly they should be read together.

L. M. MILNE-THOMSON.

[1] See NATURE, April 14, 1928, p. 580 *et seq.*

[2] NATURE, June 2, 1928, p. 885.

Our Bookshelf.

The Elements of Economic Geology. By Prof. J. W. Gregory. (Methuen's Geological Series.) Pp. xv + 312. (London: Methuen and Co., Ltd., 1927.) 10*s.* net.

THE outstanding feature of this book is the remarkable amount of cogent information which has been attractively compressed into its twenty-three chapters. The various principles and processes of the widely varied fields of mining, civil, and agricultural geology are illustrated wherever possible by examples that are personally known to the author; and as Prof. Gregory is a geologist and explorer of unrivalled experience, the book is particularly valuable both for its references to little-known sources of evidence and for the intimacy and vitality of the style in which it is written.

An unavoidable consequence of the brevity with which each topic is treated is that many of the conclusions are perforce stated dogmatically. The author attempts to disarm criticism in his preface

by writing: "If the book had been twice as long some views would not have been rejected with the apparent dogmatism rendered necessary by the limitations of space." The attempt fails, because if Prof. Gregory had wished, he could have made the book twice as long. We wish he had, for though its price is doubtless designed to attract the student, its views are not always those which will encourage teachers to recommend it. With fuller discussion these unorthodox views would themselves have become a source of stimulation, albeit to a more limited circle. Prof. Gregory regards most ores as having come from a zone lying between the barysphere and the lithosphere, "beneath the ordinary igneous rocks of the crust," and not from the igneous rocks themselves. Elsewhere he writes: "The primary mineral deposits are mainly due to ascending currents rising from the vast store of metals in the interior of the earth." Yet the vein-stones, including barite, are considered to have been largely contributed from the country rocks.

However, despite certain controversial matters such as these, on which indeed opinion is still in a state of flux, and a few careless phrases (such as "Tin is associated with hot acids appropriate to great depths"), the book is one which, in the reviewer's opinion, can be cordially recommended to every type of geological student. It is full of the life and vigour of a fascinating subject, and anyone, be he chemist or engineer, who is interested in the materials of the earth and the struggle of the elements, will dip into the book only to settle down, or to make an opportunity, to read it all. It could, perhaps, have been better still, but this is merely an appreciative criticism of its very real merits.

Visual Lines for Spectrum Analysis. By D. M. Smith. Pp. 34. (London: Adam Hilger, Ltd., 1928.) *5s.* net.

Spectrum analysis, which at one time comprised the whole function of the spectroscope, has now largely fallen out of use. This is a matter for regret, for, when the principles of the subject have been understood and a little experience has been obtained, spectroscopic methods can occupy a place in analytical work which, from considerations of delicacy and in some cases of rapidity, cannot be taken by purely chemical processes. The causes of the neglect are not difficult to understand. In the early days, before the characteristics of spectra were fully understood, there was an apparent capriciousness in the manner in which a small quantity of one substance would make its presence known, while a larger quantity of another would remain undetected, and also in the occasional occurrence of some lines of an element without the others. Furthermore, the technique of spectroscopic processes was different from that of the ordinary chemical routine, requiring special appliances and modes of procedure, and the chemist was often unable or unwilling to acquire the necessary apparatus and skill.

These difficulties have now to a large extent disappeared. Our knowledge of spectra and the circumstances of their production has removed all uncertainty from their interpretation, and the qualitative results which, within the well-understood limitations of the method, they are capable of yielding, are at least as definite as those of the chemical reaction criteria. The apparatus and method of procedure also, thanks largely to the provision made by Messrs. Adam Hilger and other manufacturers, have been reduced to a simple form, and the chemist who continues to ignore the spectroscope does so greatly to his own disadvantage.

In the book under review, methods are described by which a considerable amount of analytical work can be performed visually and with great rapidity. The sensitive lines of 52 elements are recorded, and simple methods of obtaining and identifying them—largely derived from the wide experience of Sir Herbert Jackson—are described. Particular applications of the methods are dealt with, and the material is presented in a very convenient manner, with a blank page for notes opposite each page of tables, so that the worker may insert the fruits of his own experience for future guidance. Although visual work can never wholly take the place of photography, it is doubtful if its full scope has hitherto been realised, and the book before us should go far in making its possibilities known.

Green Manuring: Principles and Practice. By Dr. Adrian J. Pieters. (The Wiley Agricultural Series.) Pp. xiv + 356. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) *22s. 6d.* net.

The growing inadequacy in the supplies of farmyard manure throughout the world has put a premium on the importance of green manuring, and much attention is being paid to the most profitable utilisation of this method of soil improvement. The actual practice is of very ancient date, but scientific interest in what really goes on in the soil when green crops are ploughed under has only been aroused comparatively recently. Dr. Pieters attacks his problem both from the theoretical and practical points of view, keeping the economic factor well before him. The effects of organic matter in the soil are both physical and biochemical, and the action of the soil micro-organisms encouraged by its presence may react favourably or unfavourably to crop plants according to circumstances. The turning under of much green material low in nitrogen may result in reduced crop yields, owing to the utilisation of the soil nitrates by micro-organisms, whereas leguminous or other material high in nitrogen benefits crops, owing to the release of ammonia which is converted into nitrates. As yet our knowledge of what actually happens in the soil is far from complete, resulting in frequent failures when green manuring is attempted under faulty conditions. Much more research is needed to enable cultivators to make the fullest and best use of this extremely valuable source of organic matter in the soil.

After due consideration of the theoretical side, the author considers the arguments for ar-

against the method from the practical point of view. Increased yields from green manuring are obtained with many crops, including corn, cotton, beets, potatoes, and sugar cane, but tobacco is more uncertain in its response. On the whole, the best results are obtained with hoed crops, for which it is specially recommended in the United States. Descriptions are given of various crops suitable for use as green manures, together with accounts of the practice of the method in various parts of the world. The volume concludes with a chapter on the economics of green manuring, indicating that various leguminous crops can profitably be grown for this purpose alone, to supplement short supplies of stable manure. A comprehensive bibliography is appended.

Survey of India. The Tides. Revised by Major C. M. Thompson. Pp. vi + 140 + 30 + 50. (Dehra Dun: Geodetic Survey of India, 1926.) 2 rupees; 3*s*. 6*d*.

THIS pamphlet forms Part 5 of the "Handbook of Professional Instructions" (Third Edition) for the Geodetic Branch of the Survey of India. The three chapters, which are separately paged, deal with "Theory and Computation," "Tidal Observations," and "The Tide-Predicting Machine." Tidal observations were commenced in India in the year 1873, and the Survey at once adopted the harmonic methods of analysis and prediction then being developed. The original methods, however, have been continued almost without modification to the present day, though there are in existence several methods of analysis which are more accurate and involve very much less labour. Similarly, in prediction, no use is made of the modern method whereby the phase-lags are modified once for all so as to use only one set of computed initial 'astronomical arguments,' instead of 40 sets, as in India. Thus it is unlikely that this volume will be used as a manual outside the Survey, especially as it would be impossible to use the instructions adequately without a supply of the printed forms used in India. Apart from this, of course, the volume appears to give a satisfactory account of the processes used.

It is now customary to run two 'curves' on the predicting-machine for heights and times respectively; the times are given by a 'gradient-curve' obtained by setting up on the machine constants resulting from differentiating the expression for the height-curve; when the gradient-curve passes through zero, the machine is usually stopped and the time read off. In India a permanent record is made electrically on a chronograph attached to the machine, and the "Instructions" give details of the mechanism and method.

From Crystal to Television, 'The Electron Bridge': a Simple Account of Wireless and Television. By Vyvyan Richards. Pp. xi + 116. (London: A. and C. Black, Ltd., 1928.) 5*s*. net.

YET another effusion dedicated to the long-suffering 'layman.' On reading through a book of this nature one cannot help wondering whether the layman would not find it much easier, and far more satisfying, to sit down to read a *confessedly* scientific or technical book, rather than to struggle through the bewildering medley of words which such a book as this contains.

The author has undoubtedly succeeded in impressing the reader that he himself is impressed with the importance and magnificence of his subject. But if perchance the reader had already formed any scientific opinions the result might be disastrous. When one learns at the outset that "there are three families of cathode rays, the alpha, the beta, and the gamma rays, these last being the X-rays that pass through our clothes and bodies and reveal our broken bones and the bullets and coins in us"; and a little later in Chapter i., "Strain is the idea that persists through all the manifestations of the ubiquitous force, electricity—a mystery which lies between matter and mind," one cannot help feeling slightly bewildered. An author who has no difficulty in drawing analogies between electric currents and human emotions, who glides from physics to psychology and metaphysics without an effort, is rather difficult for a poor layman to understand. In later chapters, however, after the metaphysical outburst has subsided and ordinary matters such as valves and gramophone 'pick ups' are under discussion, the author is obviously more 'at home.'

Aids to Biochemistry. By Dr. E. Ashley Cooper and S. D. Nicholas. (Students' Aid Series.) Pp. vii + 188. (London: Baillière, Tindall and Cox, 1927.) 4*s*. 6*d*. net.

THIS small volume contains much of the information that is found in the larger text-books on the subject: in addition, space is found for compounds which are more usually dealt with in works on organic chemistry as distinct from biochemistry. The authors state that the book is intended for purposes of revision, for which it appears eminently suitable. In addition to the theoretical treatment, the more important tests, preparations, and methods of estimation are included, so that the student can quickly revise both the practical and theoretical sides of his subject. Chapters are devoted to the chemistry of colloids, to the alkaloids, and to other compounds of general biochemical interest. The book is not intended for beginners in biochemistry: these would be well advised to read a larger manual first, in conjunction with their lectures, and only turn to this pocket volume in the last few months before their examination.

Harmonia Harmonica. By Clarence S. Hill. Vol. 2: containing Book 2—The Harmonic Chord as a Fundamental Agent in Creation; Book 3—The Harmonic Chord in Form and Design. Pp. 151. (Bournemouth: The Author, 33 Chigwell Road, 1927.) 21*s*.

THE author of this volume develops the thesis that the numbers 11 and 4/3 are the critical figures in music, the human body, the solar system, and the universe. The harmonic chord is regarded as the fundamental agent in creation, applying equally well to music, physics, chemistry, anatomy, or astrophysics.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Helium Lines in Stellar Spectra.

ALL the lines of neutral helium that can be observed in stellar spectra belong to some of the subordinate series. The ultimate lines ($1S - mP$) are in the far ultra-violet and cannot be photographed through the earth's atmosphere. The diffuse series of both the triplet system ($2p^3 - md^3$) and the singlet system ($2P - mD$) have nearly identical lower energy levels, the excitation potentials being 20·81 volts and 21·12 volts respectively (cf. H. N. Russell, *Astroph. Jour.*, **61**, 223; 1925). Accordingly, the corresponding lines of these two series should show identical intensity curves with respect to temperature, the intensity ratio of the triplet line to the singlet line remaining constant (cf. R. H. Fowler and E. A. Milne, *Mon. Not. R.A.S.*, **83**, 415; 1923).

This presupposes that the relative abundance of atoms capable of absorbing triplet or singlet lines remains unaltered by the varying physical conditions in the atmospheres of the stars. L. S. Ornstein, H. C. Burger, and W. Kapuscinsky (*Zs. f. Physik*, **51**, 34; 1928) have recently shown that this assumption is not necessarily correct. They have found that electrically excited helium shows predominantly singlet lines for pressures of between 0·01 to 0·3 mm.; for pressures between about 0·3 mm. and 1 cm. the ratio triplet/singlet gradually increases, reaching finally a constant value (approximately equal to 3 for the pair ($2p^3 - 3d^3$) and ($2P - 3D$)). They suggest that the observed changes in the relative intensities might be explained by the assumption that the initial probability of a transition from the ground-level $1S$ to one of the singlet levels is greater than to one of the triplet levels. Under low pressures the singlets will then predominate. However, under higher pressures a part of the excited atoms in the single states will lose energy by collisions with neutral atoms and will fall into the lower energy levels of the triplet system, without emitting radiation. This explains the increasing strength of the triplet lines for higher pressures.

I have recently made a considerable number of intensity estimates of the triplet absorption line λ4472 ($2p^3 - 4d^3$) and of the singlet absorption line λ4388 ($2P - 5D$). The laboratory intensities given by Russell are (6) and (3). My estimates were made from plates taken at the Yerkes Observatory.

The results for 312 *B*- and *O*-type stars show very considerable differences between the relative intensities in individual stars. Usually, λ4472 is appreciably stronger than λ4388, but there are a number of stars in which λ4388 is nearly equal to, or even slightly stronger than, λ4472.

Table 1 contains preliminary results for a few selected stars. The estimates are admittedly very uncertain, but they suffice to show the general character of the intensities. The probable error is of the order of 1 to 2 units, one unit corresponding roughly to a central intensity of 0·1 mag. The line-width is estimated on an arbitrary scale from 1 (very narrow) to 10 (very broad). The spectral types are taken from the Henry Draper Catalogue.

The observed differences in intensity (4472-4388) are much larger than can reasonably be attributed to errors of estimation or to instrumental errors, and they are almost certainly due to real differences in the atmospheres of the stars.

There is a slight indication that for the earliest spectral subdivisions, *O-B2*, the relative intensity of the triplet line is greater in the more luminous stars. If this should be the case, the triplet series would turn out to be stronger at lower pressures. This would agree with the great observed intensity of the triplet lines in the flash spectrum (cf. S. A. Mitchell, *Astrophys. Jour.*, **38**, 407, 1913; Davidson and Stratton, *Mem. R.A.S.*, **64**, Pt. 4, 1927; A. Pannekoek and M. O. J. Minnaert, *Amsterdam Akad.*, 13, Pt. 5, 1928). If we are willing to admit that the pressure in the reversing layers of *B*- and *O*-stars is of the order of 10^{-1} to 10^{-3} mm. (10^{-4} to 10^{-6} atmospheres) and that the mean pressure in the chromosphere is much lower than this, the idea suggests itself that the ratio triplet/singlet again increases for the lower pressures after passing through the minimum observed by Ornstein, Burger, and Kapuscinsky. This would, of course, necessitate a revision of their theoretical explanation, as was also pointed out by Pannekoek and Minnaert.

TABLE 1.

Star.	Sp.	λ4388.	λ4472.	Width.
Stars with relatively weak λ4388.				
λ Orionis br.	*Oe5*	1	10	4
19 Cephei	*Oe5*	5	15	5
9 Camelop.	*Bo*	1	10	3
14 Cephei	*Bo*	0	6	5
9 Cephei	*B2p*	7	15	3
υ Orionis	*B3*	6	15	1
Stars with relatively strong λ4388.				
τ Scorpii	*Bo*	7	8	3
δ Scorpii	*Bo*	8	10	9
φ′ Orionis	*Bo*	8	10	2
β Cephei	*B1*	12	10	1
ν Eridani	*B2*	12	9	3
χ² Orionis	*B2p*	9	9	2
10 Monoc.	*B3*	10	10	4
ι Herculis	*B3*	10	10	2

Table 2 contains a summary of my estimates.

TABLE 2.

Sp.	No.	λ4388.	λ4472.	Width.	4388/4472
O	9	2·2	6·7	5·9	0·33
BO	17	4·2	7·1	5·3	0·59
B1	14	6·8	8·1	4·3	0·84
B2	20	6·7	7·9	4·8	0·85
B3	92	4·8	6·7	5·8	0·72
B5	59	2·0	4·2	4·9	0·48
B8	66	1·3	3·1	4·3	0·42
B9	35	0·9	2·4	4·0	0·37

The maxima of the two intensity curves fall between *B1* and *B2*. However, the curve for λ4388 is steeper than that for λ4472, the ratio 4388/4472 reaching a maximum between *B1* and *B2*. The earliest spectral subdivisions show relatively very weak λ4388.

The mean intensity from all stars is 3·2 for λ4388 and 5·2 for λ4472, these values nearly agreeing with those of Russell. We conclude that while the relative abundance of atoms in the mp^3 and mP levels is subject to considerable variations in different stars, the average ratio triplet/singlet in stellar spectra is not very different from that observed in the laboratory under normal pressures.

OTTO STRUVE.

Observatory, Cambridge,
Nov. 15.

Striations in Explosive Flames.

IN a recent paper by Egerton and Gates (*Proc. Roy. Soc.*, A, **116**, 516; 1927), reference is made to peculiarities exhibited by certain flame photographs (not reproduced) obtained, on a rapidly revolving film, when mixtures $1C_2H_2 : 2{\cdot}5O_2 : 10N_2$ were ignited at one end of a closed cylinder 19 cm. long and of 10·7 cm. internal diameter, as follows: "Some of the photographs show distinct closely-spaced bands, indicating that the combustion has a vibratory character. The number of vibrations per second in the after-flame is about 2500, and the spacing is consistent with the view that successive sound waves are reflected from the end-plates."

The accompanying photograph (Fig. 1, a negative) shows striations in the flame (more particularly in the after-flame) of an explosion of a 3·35 per cent pentane-air mixture at 4 atm. initial pressure ignited at one end of a horizontal cylinder 38 cm. long and of 15·2 cm. internal diameter. A manometer of the diaphragm type, fixed at the end of the cylinder distant from the point of ignition, recorded the fluctuations of pressure within the cylinder simultaneously with the flame-photograph. The frequency of the striations is 1200 per second, a value which we have found to be independent both of the composition and of the initial pressure of the explosive mixture. When, by the rapid rotation of a fan, a high degree of turbulence was created within the mixture during its inflammation, the bands in the after-flame were less distinct, but their spacing was the same. These observations, together with the fact that the frequency of the striations observed by Egerton and Gates and by ourselves varies inversely as the lengths of our explosion vessels, seem to preclude the possibility of their being due to helical movement of the flames, such as has been shown by Campbell and Finch (*J. Chem. Soc.*, 2094; 1928) to occur during the explosion wave in certain gaseous mixtures. The most probable explanation of the striations in our photographs seems to be that given by Egerton and Gates for theirs, namely, a stationary wave compounded of sound-waves reflected from the opposite end-plates of the cylinder.

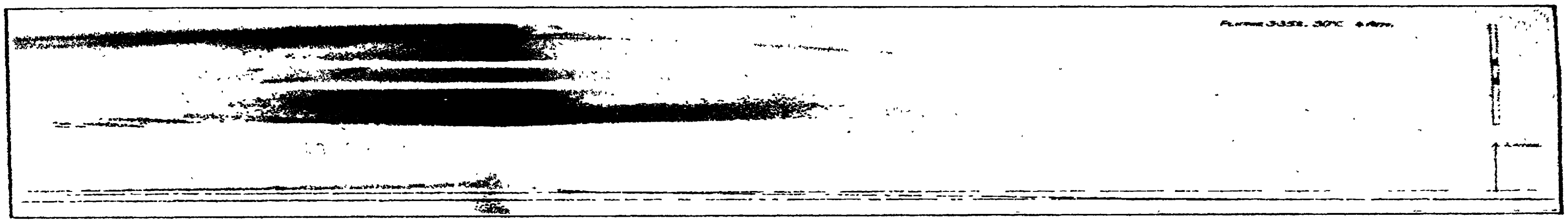

FIG. 1.—Flame photograph and pressure record of explosion of 3·35 per cent pentane-air. Time intervals, 1/100 sec.

This striated appearance of the flame during an explosion invariably precedes a 'knock' in our closed cylinder which appears to be closely related to 'pinking' in an internal combustion engine.

G. B. MAXWELL.
R. V. WHEELER.

Department of Fuel Technology,
University of Sheffield.

The Understanding of Relativity.

I CAN understand a good deal of H. D.'s courteous reply to my letter (NATURE, Nov. 24, p. 808), for example, that there are degrees in understanding. But much remains as to which I should like information. I know I am ignorant, but since my state of mind is almost universally representative, it is important. Is knowledge of the fact that clocks in rapid relative motion do not keep time derived from abstruse calculation, or from actual observation? If the latter, is there any explanation of that which seems to the ordinary man unaccountable? I assume that the swing of the pendulum of the clock in motion is not disturbed by its speed, or by a changing pull of gravity; for such alteration would be due to simple mechanical causes, easily explainable, and not due to what I suppose is meant by relativity—a mystical conception which appears to result in contradictions.

What does "curvature of space" mean? I can understand the curvature of a given area of space, for example, that occupied by the earth. But we are within illimitable space. Is curvature of such space a necessary axiom of thought? If so, why? We are told of straight lines, and also of their curvature. To the ordinary man this seems a contradiction in terms. We are told of parallel lines and of their meeting. Again we have a contradiction. On earth we have curved lines of longitude; they meet, but are not parallel. We have curved lines of latitude; they are parallel and never meet—not even if we trace such lines round and round the earth, in the same latitudes to all eternity; or so it seems to me.

Suppose two observers, *A* and *B*, both gifted with supernatural powers of seeing, stood a yard apart, with eyes on the same plane, and gazed at spots, also a yard apart and on the same plane, situated on an immensely distant object (say a star), then their lines of sight would be parallel. But where would they meet? At a spot beyond the star? But suppose the observers gazed at points a yard apart at this other spot? And so on. I can conceive that the lines of light proceeding from the star might curve for some reason—gravity or what not—but the curvature of lines passing through space is one thing; the curvature of space itself is quite another thing. Must we assume that, even in theory, straight and

parallel lines are inconceivable. If this is not meant by our teachers, what then is meant ?

I cannot help thinking that at the back of all this apparent contradiction lies the essential common sense of science. Because of the character of the men who enunciate these seeming paradoxes, the ordinary man does not doubt. But he is puzzled when he is asked to believe, for example, that straight lines are not straight, or parallel lines parallel—even in thought. As always hitherto in science, I think it must be possible for the thinkers who seem to enunciate paradoxes to clear up the mystery by means of a few simple illustrations. It is profoundly wrong to state that the man who seeks to follow science must first believe. His belief is worthless unless he also understands. For him it is mere dogma when it is stated that clocks cannot keep time merely because one of them is in rapid motion, that straight lines curve, and that parallel lines meet. I hope H. D. will not think that I am carping at his article. I do not doubt the correctness of his opinions. But I do want to find a way through apparent contradictions, not all of which are his.

G. ARCHDALL REID.

20 Lennox Road South, Southsea.

IT is impossible in the space of a letter to deal adequately with all the points raised by Sir Archdall Reid. He has no doubt read most of the well-known expositions of relativity, but perhaps I might refer him to Professor Eddington's latest book, "The Nature of the Physical World." I know of no clearer or more generally admirable account of the relativity of space and time than that contained in its early chapters. Here I can only answer summarily the particular questions asked.

The idea that clocks in rapid relative motion do not keep time is, as a general principle, derived from not very abstruse calculations based on actual observation. In a special case it may be said, in a sense, to be derived directly from observation. If we are willing to accept an atom as a clock and its radiation as a measure of the time it keeps, then the well-known Doppler principle, verified by observations in the solar system, is a directly measured testimony to the idea. But other factors also are involved here, and perhaps it is scarcely fair to regard it as observational proof. The idea is not mystical—except in the sense in which, I suppose, every fundamental physical fact is mystical—and it certainly does not result in contradictions.

The 'curvature of space' is a symbolical expression representing the idea that if one proceeds in a certain direction he will not continue indefinitely to recede from his starting-point ; he will ultimately, without changing his direction, approach it again, just as one does in travelling on what we ordinarily regard as a 'curved' surface, *e.g.*, a sphere. The idea is not a "necessary axiom of thought," although it originated, as a possibility, long before the theory of relativity. What relativity has done is to make it probable that the physical space of our experience has 'curvature.' If parallel lines are defined as lines which always keep the same distance apart, then obviously they cannot meet, but the 'parallel' lines which are said to meet if sufficiently prolonged are not so defined. The geometrical definition of parallel lines has been that they are straight lines which meet at infinity. In the space contemplated by relativity, straight lines, as ordinarily imagined, and infinity (which belongs to hypothetical, euclidean space, and is of course quite inconceivable) do not exist, and a new definition is necessary, which mathematicians, if they regard the conception of parallelism as a useful one, have no doubt provided themselves with. Subject to correction by them, I would suggest that in 'spherical' space, parallel lines might be defined as 'straight' lines which intersect at two points the distance apart of which is the greatest possible, where by a 'straight' line is understood one of which any portion lies along the shortest (or longest) distance between its ends. The portions of such lines which we, in the minute terrestrial region of space, recognise as parallel would then be analogous to the almost infinitesimal arcs of two meridians of longitude at the equator, and not to elements of two circles of latitude.

The lines of sight of Sir Archdall Reid's two observers would therefore not be 'parallel,' although, if the star were among the near ones, their deviation from parallelism would be too small to be detected. I do not know if the preceding paragraph will clear up all Sir Archdall Reid's difficulties on this point, but it should at least make it clear that the contradiction with which he is troubled does not exist. Relativity or no relativity, lines cannot both meet and never meet.

I quite agree that "It is profoundly wrong to state that the man who seeks to follow science must first believe," but this statement was not made or implied in the original article. The contention was that what is called lack of understanding of relativity is usually unbelief ; the article put forward a diagnosis of a complaint, not a prescription for keeping well.

H. D.

THERE appears to be a rather interesting reversal in the direction of our minds between cause and effect in regard to some of the problems involved in relativity. The Michelson-Morley experiment was originally intended to detect the absolute movement of the earth through space ; and it failed because the anticipated shift of the interference bands did not occur ; and because it failed the movement through space remained undetected ; and various physical theories were suggested to account for the failure.

The whole situation is now approached from the opposite end. The impossibility of observing absolute movement is elevated into a fixed fundamental principle which we are asked to accept without being too curious or insistent in demanding a physical explanation. We are free, if we like, to regard it, as we regard the point of maximum density of water, as an evidence of beneficent design, since it is on this principle that the uniformity of Nature, or the invariance of general laws, depends. The Michelson-Morley 'failure' is now recognised merely as an illustration, a direct and inevitable result, of this principle. The same principle is applied to the relativity contraction of measured lengths and the slowing of clocks as between two systems S and S'. We are discouraged from attempting to explain or explain away, on any physical basis, the apparent paradoxes which most paradoxically have accompanied the expression of Nature's invariance in mathematical form.

This new point of view for the study of relativity will be welcomed even by those who believe that a real though quite undiscoverable Fitzgerald contraction, due to absolute movement, underlies and to a large extent accounts for the relativity contractions and differences of clock rates and synchronisation which appear in the transformation formulæ. Belief or disbelief in this contraction only modifies our ideas, and does not affect experimental facts. The application of the principle that *absolute movement cannot be observed*, affords a satisfactory 'reason why' to much that must otherwise remain perplexing to the ordinary man.

H. C. BROWNE.

Dublin, Dec. 7.

The Isotope Effect in the Spectrum of Chlorine.

THREE strong bands in the absorption spectrum of chlorine have been analysed and the rotation constants for the normal and excited states of the chlorine molecule determined. These bands have been allocated by Kuhn (*Zeits. f. Phys.*, **39**, 77; 1926) to one vibration progression having a common initial level (probably 2) in absorption, the final states being denoted by the arbitrary numbers 5, 6, and 7. The $2 \rightarrow 5$ and $2 \rightarrow 7$ bands consist of single P and R branches from which a set of term differences can be found for each band, some twelve of one set being in good agreement with the corresponding members of the other set. The $2 \rightarrow 6$ band appears to consist of a single series of lines, each of which must, however, be in reality double, since on that assumption a set of term differences can be found which agrees well with the previous ones. These three bands show the phenomenon of alternation of intensity in the lines comprising them, as is to be expected in a symmetrical molecule. The ratio of intensities is approximately 1·4 : 1. There are indications that there may be a progressive diminution in this ratio in going from F_2 through Cl_2 and Br_2 to I_2, and it is hoped that work on Br_2 now in progress in this laboratory (Prof. J. Patkowski) may throw further light on this question.

A fourth weaker band which is displaced about 9·6 cm.$^{-1}$ with respect to the $2 \rightarrow 6$ band has been observed and analysed, and is found to have the same structure as the $2 \rightarrow 6$ band (*i.e.* superposed P and R branches) but slightly different rotation constants; this is ascribed to one of the isotopes of chlorine. Since this element has isotopes 35 and 37 present in the ratio 3·35 : 1, three kinds of molecules, $Cl_{35}Cl_{35}$, $Cl_{35}Cl_{37}$, and $Cl_{37}Cl_{37}$, must exist in the proportions 11·2 : 6·7 : 1 respectively. The three strong bands must be due to absorption by the most abundant molecule $Cl_{35}Cl_{35}$ and the weaker companion of the $2 \rightarrow 6$ band due to $Cl_{35}Cl_{37}$. Similar companions in the case of the $2 \rightarrow 5$ and $2 \rightarrow 7$ bands have been observed, but not yet fully analysed on account of the complexity of the spectrum in these regions. Hitherto the isotopic band due to $Cl_{37}Cl_{37}$, which must be very weak, has not been observed.

The nuclear separations of the $(2 \rightarrow 6)_{35-35}$ and $(2 \rightarrow 6)_{35-37}$ bands have been calculated and are found to agree closely both in the normal and excited states (see table of constants), although the values of the rotation constants differ appreciably in the two cases.

The most interesting feature of the $(2 \rightarrow 6)_{35-37}$ band is that, unlike the other bands, no alternation of intensity in its lines can be observed. This result provides direct confirmation of the theoretical conclusion that alternating intensities arise from equality of the nuclei, since the nuclear masses in $Cl_{35}Cl_{37}$ are unequal, whilst in every other respect this molecule is identical with the symmetrical molecule $Cl_{35}Cl_{35}$. Photometric measurements made on the least confused lines in the $(2 \rightarrow 6)_{35-35}$ and $(2 \rightarrow 6)_{35-37}$ bands indicate that the ratio of the intensity of the $(2 \rightarrow 6)_{35-37}$ band to the mean intensity of the $(2 \rightarrow 6)_{35-35}$ band is approximately that to be expected from the relative numbers in which the molecules exist, namely, 1 : 1·7.

The absolute values of the upper vibration quantum numbers have been calculated from the isotope effect and are found to be 17, 18, and 19 for the bands in which this number has been previously denoted by 5, 6, and 7 respectively. The available vibrational data are not sufficiently exact to decide whether half-integral vibration quantum numbers should be used, as is predicted by the wave mechanics.

CONSTANTS.

Band.	B''.	B'.	I''.	I'.	r''.	r'.
$(2 \rightarrow 17)_{35-35}$	·2412 cm.$^{-1}$	·1254 cm.$^{-1}$	114×10^{-40} gm. cm.^{2}	220×10^{-40} gm. cm.^{2}	$·991 \times 10^{-8}$ cm.	$1·38 \times 10^{-8}$ cm.
$(2 \rightarrow 18)_{35-35}$	·2412 ,,	·1209 ,,	114 ,,	228 ,,	·991 ,,	1·40 ,,
$(2 \rightarrow 18)_{35-37}$	·2337 ,,	·1164 ,,	118 ,,	237 ,,	·993 ,,	1·41 ,,
$(2 \rightarrow 19)_{35-35}$	·2412 ,,	·1166 ,,	114 ,,	237 ,,	·991 ,,	1·43 ,,

In the above table, r is half the internuclear distance. The constants in the upper and lower electronic states are denoted as usual by $'$ and $''$ respectively, and the absolute values of the upper vibrational quantum number are used in place of the arbitrary ones.

A. ELLIOTT.

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Newcastle-upon-Tyne.

Cosmic Radiation and Radioactive Disintegration.

A THEORY of radioactivity has been proposed by Perrin, who suggested that the disintegration of the radioactive elements may be due to their absorption of cosmic radiations. Former efforts to verify this theory have resulted in unsuccessful attempts to alter the rate of disintegration by subjecting radio-elements to intense gamma radiation and also by shielding them from external radiations.

However, to test the hypothesis further, the activity of a source of polonium has been actually measured by me at 1150 feet below the surface of the earth, at the bottom of the New Jersey Zinc Company's mine, Franklin, N.J. At this depth, it is thought that enough of the cosmic radiation would be absorbed to insure a change in the radioactivity of the specimen if that activity were a phenomenon produced by this radiation. The apparatus used comprised an ionisation chamber arranged to deliver a saturation current into a single-fibre electrometer of sensitivity 15 divisions per volt. The current was compensated by a measured current supplied by altering the potential of the external member of a standard condenser the internal member of which was connected to the electrometer. The results of the measurements showed that the activity did not change by more than about one per cent (which was the limit of accuracy of the experiment) when the polonium was taken from the surface of the earth to the bottom of the mine. The activity of the rocks of the mine was found to be small in comparison with the activity of the polonium, and therefore did not produce appreciable errors in the measurements.

We thus conclude that if Perrin's theory is to account for radioactive disintegration, the cosmic radiation responsible for the disintegration must be of such a penetrating power that it remains practically unabsorbed in going about eleven hundred feet through the earth and must yet have the property that it can be appreciably absorbed by relatively small amounts of radioactive elements.

L. R. MAXWELL.

Bartol Research Foundation of
The Franklin Institute,
Philadelphia, Pa.

IN view of the foregoing interesting experiments of Dr. L. R. Maxwell, the following considerations will be of interest since they suggest that a modern view of the nature of cosmic radiation would render highly improbable any measurable effect of such a radiation in the matter of stimulating radioactivity.

According to the experiments of Millikan and Cameron, the absorption coefficient of the cosmic radiation is of the order of magnitude of 0·1 per metre of water, and, according to Dirac's formula (*Proc. Roy. Soc.*, **111**, 423; 1926), corresponds to such a frequency of radiation as would cause an individual cosmic ray to have an energy of about $1\cdot3 \times 10^{-4}$ ergs and be capable of producing about $0\cdot54 \times 10^{7}$ ions in air. If, following Millikan, we assume that the cosmic radiation produces on the average (through its direct and secondary (indirect) radiations) 1·4 ions per c.c. per second, we see that on the average there should only be about $1\cdot4/(0\cdot54 \times 10^{7})$, *i.e.* $2\cdot6 \times 10^{-7}$ primary cosmic rays absorbed per c.c. per second, or about $1\cdot3 \times 10^{-4}$ primary cosmic rays per gram of absorbing materials. The saturation current due to the polonium in Dr. Maxwell's experiment was about 0·3 e.s.u. and corresponds to about 10^{-11} grams of polonium. It is therefore clear that we should only expect a cosmic ray to be absorbed by one of these atoms once in about 10^{15} seconds, *i.e.* once in twenty million years. This consideration would appear to render very improbable a direct effect of the cosmic radiation in stimulating radioactivity even in the most favourable case where the volume of the preparation under examination was much larger than that used by Dr. Maxwell; for, while radioactive disintegration does take place with discontinuities, the process is sensibly continuous as compared with such an enormous period as that calculated above.

W. F. G. SWANN.

Bartol Research Foundation of
The Franklin Institute,
Philadelphia, Pa.

A Function of the Adrenal Cortex.

IF both adrenal bodies be extirpated in a cat, the animal dies in three or four days. If the same operation be carried out in a decerebrate cat (brain removed to the level of the corpora quadrigemina) death ensues in less than an hour—usually within half an hour. The fatal result is due to failure of respiration, and may be indefinitely postponed by artificial respiration.

Close behind each adrenal is constantly found a lymph node, united to the cortex of the adrenal by a plexus of lymphatic vessels. If this plexus be torn across, or if the lymph node itself be removed, the animal will succumb with the same symptoms and within the same time as if both adrenal bodies had been removed. Further, if the lymph be prevented from reaching the blood-stream by tying both innominate veins we get a similar series of events.

In several experiments, when the breathing has only stopped for a short time and the heart is still beating strongly, we have succeeded in temporarily restoring the respiratory function by means of fresh watery extracts of the adrenal cortex.

Destruction of the medulla of the glands produces no such results. Numerous controls of various kinds have been carried out. Extirpation of the semilunar ganglia and section of all nerves in the region are without effect, so long as the arterial supply to the gland is not seriously interfered with.

There seems to be no escape from the conclusion that some substance, which we propose to call *pneumin*, essential for respiration, is manufactured in the adrenal cortex and discharged into the circulation through the lymphatics. The conviction that cortex and not medulla of the gland is concerned is based upon the well-known fact that it is the cortex and not medulla which is essential for life, and that in the present series of experiments destruction of the medulla by cauterisation produces none of the results described above.

SWALE VINCENT.
J. H. THOMPSON.

Department of Physiology,
Middlesex Hospital Medical School, W.1.

Copper in Antiquity.

WITH regard to the British Association Research Committee's interim report on the sources of Early Sumerian copper (and bronze), referred to in NATURE of Dec. 8, p. 886, I should like to direct particular attention to the ancient workings for tin about Rooiberg and Blaubank in the Transvaal. The quantities of bronze now known to have been employed in early times would have involved very considerable ancient workings of copper nickel deposits if the nickel found in such bronzes had been mixed with the copper.

The few deposits of nickel and copper in Europe are not associated with ancient workings, whilst the chief ancient workings for copper in Europe and Asia are not associated with nickel.

In the Transvaal, on the other hand, nickel occurs in the same areas as the tin, and ancient smelting has been carried on there on an immense scale. An examination of the slag by H. S. Gordon has shown that the ancients smelted there for the direct production of bronze, *i.e.* they brought their copper ore to the tin- and nickel-bearing areas of the Waterberg.

Some investigators have estimated the production of bronze and tin in the Transvaal as totalling millions of tons. Such a production is utterly in excess of any possible local demand and indicates a distribution of the metals throughout the Old World.

It is the large scale of production in Southern Africa (in one single area there are said to be remains of forty-three furnaces) which points most to this area being the main source of the production of bronze in early days. No large ancient slag heaps from the smelting of tin *and* copper have been found elsewhere. A reprint of the papers already published locally on these workings, and a special request for more local information, would afford an interesting item for discussion at the forthcoming meeting of the British Association in South Africa next year.

BERNARD W. HOLMAN.

Royal School of Mines,
London, S.W.7.

A Neglected Aspect of Scientific Research.

THERE are thousands of workers and scores of secretaries of scientific societies in Great Britain alone who might admire and accept the value of the contentions in the excellent leader in NATURE of Dec. 15 on this subject, *but* what they want is the name and address of some person to whom they can refer the problem which is set to them by every technical paper, lecture, or note with which they are confronted.

"How do I index THIS?" is the question they ask—for they are quite unversed in the science of indexing. In a few months of practice, under the guidance (say by telephone) of a skilled indexer, the tyro will acquire the necessary knowledge and will not improbably thereafter continue to contribute to the world's store of available scientific records. The editors of scientific journals might, for example, mark each article with a bracketted numeral, being the correct Brussels Classification number of the subject discussed.

MERVYN O'GORMAN.

The *Dana* Expedition.

IT is just a little more than fifty years since H.M.S. *Challenger* came home, with Wyville Thomson and Moseley aboard, and a young assistant of the name of John Murray. Only a few of our older men remember the fitting-out of that goodly ship, or even her homecoming; but many remember the busy years when naturalists all the world over divided the spoil and shared the harvest of discovery. The quickening impulse of that celebrated expedition lasted long; but in all the past half-century no other ship has sailed from a British port to explore the oceans of the world. The deep sea has been studied here and there so far as scanty opportunities permitted; British home waters have not been neglected, the Indian Ocean has had its turn, and the *Discovery* expedition is no small thing. But, after all, it is Germany and Norway, and Denmark in particular, that have carried on the work of the *Challenger*. The Danes have been especially fortunate. In Dr. Johannes Schmidt they have a skilled investigator and a born leader of men. They have a ship, the *Dana*, built and planned for scientific work, and equipped with every modern device and invention to that end; the Danish Government seems always ready to put her in commission, and the rich Carlsberg Fund is always at hand to defray the heavy cost of a voyage.

To explore the ocean in such a ship is a very different thing from the old days of the *Challenger*. Then the ship's company toiled all day long and far into the night over the clumsy winches and great hempen cables to get the deep-sea dredge aboard. Now dredge or trawl come up handsomely, with the easy help of an electric winch, on a light wire-rope of phosphor-bronze. As for the deep-sea soundings, there is neither lead-line nor even Lord Kelvin's pianoforte sounding-wire any more; but all day and all night long Echo keeps calling the depth, even over the great depths of the ocean. Moreover, as a Government ship, the *Dana* is all the while in touch by wireless with her base, and the staff in Copenhagen know what she is doing day by day, even in the middle of the Pacific. Add to all this the vastly improved methods of preserving specimens, compared with the simple but far from inefficient means in use aboard the *Challenger*. Surely the scientific harvest of a deep-sea expedition should nowadays be rich indeed.

The voyage now in progress is the greatest which the *Dana* has undertaken, though her leader made a preliminary cruise over the greater part of her route some three or four years ago. The ship left Copenhagen last June, took a zigzag course to Panama, is now somewhere between Tahiti and Noumea, and is due to reach New Zealand soon after New Year's day. There Dr. Johannes Schmidt will join his ship for the rest of her long cruise, to the western Pacific, the Indian Archipelago, and home, some time in 1930, by way of Madagascar and East Africa. Dr. P. Jespersen, Dr. Th. Mortensen, Prof. Ove Paulsen, and Dr. J. N. Neilson will accompany the ship, some for part and some for all of her long voyage.

The *Dana's* route is planned, and the whole expedition is devised, for the further study of the natural history of the eel. Whatever other men have done (Grassi in particular, and Hjort and others) to unravel the life-history of the eel, it is Johannes Schmidt who has for many years been without question the chief student and highest authority in this matter. The story which we all learn is the story as he has told it. We know, from him, how from the rivers of Great Britain the eels hie away to ocean-depths over by the Sargasso Sea, and spawn and afterwards perish there; and how their offspring journey slowly homeward to homes which

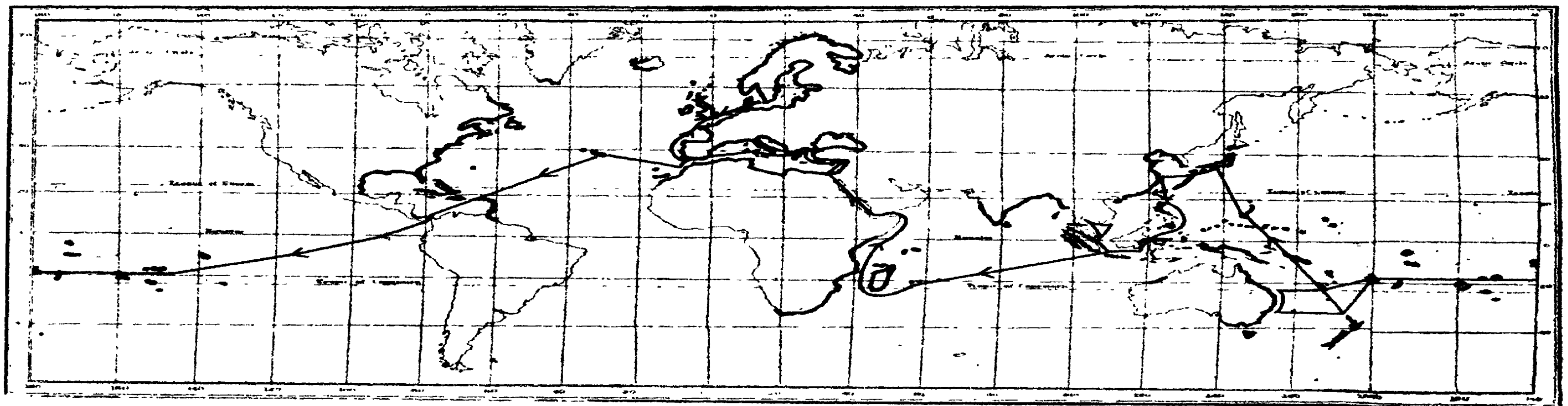

FIG. 1.—Chart showing the projected cruise of the *Dana*. The blackened parts show the distribution of the eels. After Schmidt.

they never saw, undergoing their strange transformation on the way. Not the least curious thing which he has told us is that the European and American eels have not only similar habits but also resort to the same breeding ground: from which the offspring of the latter turn westward and take the short road home, while the European eel-fry have all the broad Atlantic before them.

Some fifty years ago that first-class ichthyologist, Dr. Günther, believed that there were two species of eels in Europe and three in America, one species being common to both sides of the Atlantic; we now know, from Dr. Schmidt, that there is but one species on the west and another on the east side of the North Atlantic. The southern oceans, on the other hand, contain many species, and somewhere in the western Pacific lie the headquarters of the tribe. The general distribution of the genus *Anguilla* is very curious and interesting. Our European species ranges all the way from the White Sea to the Black, and is said even to slip through the Suez Canal now and then; but apart from such chance immigrants the Red Sea and also the Persian Gulf are barren of eels. In India two species are common, one with long fins and one with short; and there are several more in the tropical parts of the Indian Ocean, one of them extending to East Africa. There are eels in Madagascar, Mauritius, and all the other islands in the western part of the Indian Ocean, and so there are on the other side, all the way from the Andamans to Sumatra, Java, and New Guinea; but (with a trifling exception) they are lacking on the whole of the north, west, and south-west coasts of Australia. There are eels in China and Japan, in the Philippines and throughout Polynesia (except in the Sandwich Islands)—all the way from North Japan to New Zealand; save only that they become scarce in the inner waters of the Malay Archipelago, between Siam and the northern coasts of Sumatra and Borneo. On the other hand, they are plentiful on all the coasts or islands (save that part of Australia already mentioned) which face the deep waters of the Indian Ocean or of the Pacific. In New Zealand, in Tahiti, and in many other Pacific Islands they are very abundant and grow to an enormous size; but on the other side of the Pacific, all the way from Kamtchatka to Cape Horn, eels are conspicuous by their absence.

FIG. 2.—The Danish research ship *Dana*.

This is a very striking fact, and not less striking is their total absence from the South Atlantic. They are plentiful (as we all know) on both sides of the North Atlantic, and on the western side they extend through the West Indies as far as the north coast of South America; but there they stop, and none are found either on the east coast of South America or on the opposite coast of Africa south of Morocco.

Here is a complicated problem. Why are eels plentiful throughout the western Pacific, but absent from all the eastern half of that ocean? Why are they present on both sides of the North Atlantic ocean, but absent from both sides of the South Atlantic? Why are they plentiful on one side of Australia and absent from the other? In the strictest sense one may call such a problem as this an interesting one, because it is plain that it can be only solved by putting two and two together over a wide range of physical as well as biological investigations. Problems of geographical distribution are generally interesting, though we are often put to our wits' end to solve them. When we find the tapirs, the king-crabs, or the lung-fishes each with two or more separate and remote habitations, we are content to invoke the 'historic factor,' and to take it for granted that a wider distribution in some former age preceded and led to the present conditions. The distribution of coral reefs we can more or less satisfactorily explain by existing hydrographical phenomena, with again some help from the historic factor of geology. Most of the deep sea fishes seem to roam the wide world over, as though the general uniformity of the great depths of the sea set no barriers in their way. But the eels, though capable of travelling immense distances, nevertheless have their well-defined areas of distribution, both for this or that particular species, and for the family as a whole. The *Dana* goes out to study the habits and the distribution of the various eels, but there is nothing in the chemistry and physics of all the oceans which need be thought alien to that biological problem: hydrography is a great and an indispensable part of her work.

The Japanese eel, the eel of the North Pacific, is closely akin in habits and otherwise to the two eels of the Atlantic; and, just as the young of our own eels traverse the shallows of the North Sea to enter British rivers, so do those of the Japanese species cross the shallows of the Yellow Sea on their way to the rivers of China. In all probability they breed in the deep warm water south-east of Japan, in the region where the Kuro Siwa takes its rise, under conditions somewhat like to (though somewhat cooler than) those which obtain in the Sargasso Sea. But there is no eel in the north

Pacific which takes the longer journey (as the European eel does) from these warm waters to the eastern side of the ocean. A very similar patch, or tongue, of warm water runs far to the eastward from the Queensland coast, to the northward of New Zealand, and here possibly, and even probably, is the chief breeding place of the southern eels. At the same time the comparatively limited distribution of some of the Pacific eels goes to show that these are poor travellers, and are somehow or other hedged in by unknown barriers. We begin to see what a wonderful field of investigation Dr. Johannes Schmidt has made his own. For a score of different eels the breeding place of each has to be determined and the routes followed by old and young have to be mapped out; agreement with the known habits of our own eels has perchance to be verified, or perchance to be disproved. Every locality and route must be studied in regard to its hydrographical features, and what they have in common must be made clear. In the end general truths and common features may emerge, giving an insight into the history of the eel-tribe and the sources from which their strange habits or instincts came.

There is a curious little point, to which Dr. Johannes Schmidt has directed attention, in the name which the eel receives among many remote races of men. It is called 'Tuna' by the Maori, and its name in Samoa, the Philippine Islands, and even in Madagascar is but a slight variant of the same word. This looks like a page from that early history of the migrations of seafaring men of which Prof. Elliot Smith and others have told us. When we find in the Semitic languages and in Greek what looks very like the same word in *θύννος* or *tunny*, though it be used of another fish, I should not scout as impossible a connexion between all of these; for we begin to see that a few animal names are so old as to care little for linguistic boundaries, and are perhaps the oldest of all old words surviving in the speech of men.

D. W. T.

Oil and the Oil Engine.

SINCE the foundation of the mineral oil industry many a prediction of an oil shortage to occur within the lifetime of the prophet has been made; but in spite of the astounding increase in the use of oil as a fuel within the last two decades, a consumption which is certainly still far from having reached its peak value, there is not the remotest reason to anticipate an oil shortage within the next hundred years. Indeed, in view of the known reserves of oil in hitherto untapped fields, and of the vast quantities still remaining underground in partially exploited districts, future generations should be secure against an oil shortage for at least a thousand years. To-day, the world's output of oil is far below the capacity of wells actually in production, and were it not for output-limiting agreements between oil-producing interests the market would be flooded.

The crude mineral oils do not reach the consumer as such, for being complex mixtures of hydrocarbons of widely varying volatility, they must first be subjected to distillation and other processes whereby the crude product is divided into four main groups, the boiling-point ranges of which serve for their chief market classification. Petrol is the first of these fractions, distilling over at temperatures up to 150° C., and constitutes the main supply of the world's motor spirit. Kerosene or paraffin oil, distilling between 150° and 300° C., is chiefly in demand as an illuminant. The heavy fuel oils, boiling between 300° and 350° C., are burnt directly for steam raising or in engines of the Diesel type. The fourth and final fraction supplies mainly lubricants, waxes, and pitch.

The relative proportions of these four fractions vary with the nature of the crude oil; petrol is most in demand and therefore commands the highest price. So much is this the case to-day that the petrol fraction, although in the best of oils never amounting to more than 20 per cent of the total distillation products, pays for practically half the total oil production and refining costs. Thus there is every incentive to increase the yield of petrol by the thermal decomposition or 'cracking' of the heavier fractions. So successfully have such methods been applied that, to-day, the price of petrol shows the least increase since 1913 of any of the commodities in everyday use, and this in spite of greatly increased costs of production and refining.

The remarkable development within the last fourteen years of cracking processes is clearly brought out in the following table:

PETROL PRODUCTION IN THE U.S.A. IN MILLIONS OF GALLONS.

Year.	By direct Distillation.	By Condensation from Natural Gas.	By Cracking.	Petrol Production in per cent of Crude Oil.
1914	1112			18·2
1919	2601	95	320	25·9
1923	4461	175	1120	30·4
1927	6213	1029	3239	36·7

But for this development in cracking and other processes it is clear that, in order to meet the demand for petrol as a motor spirit, production would have had to be practically doubled, with the result that the petrol fraction would have had to bear some 80 to 90 per cent of the total crude oil production and refining costs, and the market price of petrol would have been doubled or even trebled. Thus the increased efficiency in refining, which is chiefly a result of the introduction of cracking processes, has not only kept down the price of petrol to the consumer, but has also prevented a wasteful flooding of the market for heavy oil, so that the price obtained for this fraction is more proportionate to production and refining costs than would otherwise have been the case.

Even so, the relative prices of petrol and heavy oil, when compared on an energy content basis, are approximately 3 or 4 to 1. There is thus every incentive for the development of heavy-oil-burning engines suitable for use under conditions in which the petrol driven motor has hitherto reigned supreme. A move in this direction has already been made by the introduction of the Diesel-type heavy-oil-burning engine for the purposes of motor road transport.

Diesel engines can be conveniently classified into three main types, according to the speed at which they are designed to run. Low and medium speed Diesel engines which develop their full power at speeds below 500 and 1000 r.p.m. respectively are, chiefly owing to considerations of weight per unit of power developed, practically restricted to use in stationary installations or for marine purposes, and to a less extent in railway locomotive practice. High speed Diesel engines running at speeds of more than 1000 r.p.m. have the advantage of higher power-weight ratios than those possessed by the lower running types, and are being successfully employed for heavy road transport. It is probable that the use of such engines will, in time, be extended to the lighter classes of road transport vehicles and even to aircraft.

In addition to the great saving in fuel costs, the use of the Diesel engine offers further important advantages such as greater efficiency, compression ignition, less volume of fuel carried for a given mileage, practically eliminated fire risks, and a reduction in the size and area of the cooling system. The ultimate successful application to road and air transport of the high-speed Diesel engine will, however, depend largely upon the extent to which the designer is successful in reducing its inherent disadvantages, the chief of which are low power-weight ratio, starting difficulties, the offensive nature of the exhaust gases, oil creepage, and heavy transmission stresses. It remains to be seen, if and when the heavy oil engine has been sufficiently developed to compete successfully with the petrol motor, whether the resulting demand for heavy oil will not lead to such a levelling out of prices for the respective fuels that the Diesel engine will be robbed of one of its chief merits.

These recent developments in the heavy oil engine and its uses are a strong incentive to continued improvement in the petrol motor. Until the gas turbine has become a working proposition, the main line of improvement in the reciprocating type of engine lies in the direction of an increase in the compression ratio, an upper limit to which is set by the incidence of the well-known phenomenon of 'knock.' In attacking this problem two lines are being actively pursued. Some classes of motor spirit, such as benzol and other aromatic hydrocarbons, do not give rise to knock, no matter how high the compression ratio may be; but by far the larger bulk of our petrol supplies are rich in paraffins which are notorious offenders in this respect. To reduce the trouble the chemist is engaged in studying the effect of blending these different classes of spirit and has also attacked, with considerable success, the problem of treating bad petrols with substances such as lead tetraethyl, small additions of which suffice to reduce their tendency to knock, so that the 'doped' fuel can be burnt in engines of a considerably higher compression ratio than would otherwise have been possible.

Further, the engineer has not failed to realise that correct cylinder head and piston design is an important factor in suppressing knock. It is now well known that, other conditions such as turbulence, freedom of the explosion chamber from hot spots, etc., being equal, the incidence of knock is largely controlled by the distance of unimpeded travel of flame through the explosive mixture near the beginning of the firing stroke. Thus the same petrol can be burnt without giving rise to knock at a higher compression ratio in a small cylinder than in one of a larger capacity. Likewise a central position of the sparking plug, or, better still, multiple point ignition, materially assists in its suppression.

The expenditure in Great Britain on petrol alone is about £60,000,000 per annum, and is steadily increasing. Practically the whole of these supplies are imported, and there is little or no prospect of home-produced spirit materially affecting this state of affairs. There is, therefore, a great inducement to use solid fuels for road transport purposes. That the coal or coke fired steam-driven lorry continues to hold its own in spite of its exceptionally low thermal efficiency is a clear indication of the vast possibilities open to a motor which would combine the efficiency of the internal combustion engine with the low cost of coal. Intensive experimental work and exhaustive tests on road vehicles fitted with internal combustion engines running on gas generated in suction producers are now being carried out in Great Britain and other countries with much promise of success.

The Ice Age and General Drayson's Theories.

FROM time to time theories claiming to be scientific are put forward, most frequently in the domain of astronomy, which fail to secure the recognition of the orthodox. For the most part they pass quickly into deserved oblivion and are heard of no more. The fate of Gen. Drayson's ideas is quite peculiar. They have been kept alive by a devoted band of disciples, but no qualified astronomer who has considered the theories can profess more than the mildest interest in them. This attitude has led to resentment, and the Draysonians have not been slow to make accusations of obscurantism against the astronomers. As the world owes its release from the tyranny of dogma to nothing so much as the development of astronomy, and as in no science is the co-operation

between professional and amateur so cordial, fruitful, and freely acknowledged, such accusations may well be dismissed with amused indifference.

About the middle of the last century Capt. A. W. Drayson, R.A., after a course of study at Greenwich Observatory, was appointed to the staff of the Royal Academy at Woolwich and gave instruction in surveying and practical astronomy for about fifteen years. Sir John Herschel's "Outlines of Astronomy" had been adopted as the official textbook, and Drayson followed its teaching for a time, evidently without appreciating the nature and limitations inherent in even an admirable example of that type of work. Eventually he became dissatisfied with Herschel's exposition of the subject of precession. At that point he might have referred to the mathematical theory, of which the results were available to him only in the barest outline. Instead of doing so, and perhaps deterred by the difficulty of such a course, Drayson embarked on a geometrical reconstruction of the precessional motion as observed over a considerable period of time. In this task he showed no little ingenuity, but the outcome was doomed to futility. Everywhere in the Draysonian literature nutation is simply ignored. Now the real problem which has to be solved is the motion of the earth's axis as a whole, and the purely empirical description of a part of it can never be satisfying. Further than this, the description, such as it is, is devoid of any dynamical basis.

The attitude of Drayson and his followers to the theory of gravitation is undefined. They are not apparently in declared opposition to it altogether, but they claim to ignore its application to the problem of precession. What they overlook is that the astronomer is not free to select. He cannot remove the rotation of the earth from the operation of a natural law, and at the same time use that very law to predict the position of the sun and moon. What Drayson found was the osculating circle to the path of the earth's pole, and it represents a fair approximation to that path over a time which is quite long in one sense but short in comparison with the precessional period. The fact that it accords with the positions on which it is based affords no justification for extrapolation beyond them, and this is the fatal defect of the theory.

Here the story might have ended, for popular interest in the subject of the earth's precession would not by itself have sufficed to keep the cult alive. This vitality has been brought about by attaching the theory to the problem of an Ice Age.[1] Drayson's next step, in fact, was precisely to indulge in that process of unlimited extrapolation which lacks all valid foundation. For what is in effect the osculating circle to the path of the earth's mean pole he found the centre 6° from the pole of the ecliptic, together with a period of nearly 32,000 years. Here, then, in a large periodic change in the obliquity of the ecliptic, is an explanation of a glacial cycle ready to hand. By this means what might have passed as a crude version of astronomical data within a limited range of time was brought into a field where uncertainty as to the facts reigns supreme and any theory enjoys unwonted freedom from critical tests.

Much of course has been written on this subject from several points of view. The difficulty is that the evidence is not so precise, coherent, and complete as to present a definite problem to astronomy at all. The demands on the geologist are heavy. He must first agree on the approximate dates when the successive glaciations happened. Then, for those dates, he must define the whole areas affected simultaneously over the whole surface of the globe. Finally, he must be prepared to state what was the distribution of land and water, and more precisely what was the elevation of the land areas, for these are constantly changing, over all past geological time. It is only when a clear statement on all these points is forthcoming that the problem will reach a stage of closer interest. For then it will pass into the hands of the meteorologist, and he will state in terms of his science how far he can go in explaining the phenomena without requiring any help in the form of exceptional or overlooked astronomical conditions. It appears quite likely that he will need no assistance at all. Those interested in this phase of the subject will find it discussed in a popular form in a recent work by Dr. C. E. P. Brooks, "Climate through the Ages." If at the end of all this there is an outstanding balance for the astronomer to settle, and he has no other means of disputing it, there is always a fund on which he can draw without disturbing his account of invested theory. For when it can be established beyond doubt that there have been times when the earth's surface has received a deficiency of heat, the obvious inference will be that the sun's radiation has fluctuated in intensity. There is no reason to assume that the sun has always produced heat at a uniform rate, but rather the contrary. Unfortunately, the geological evidence at present is too ambiguous to turn a fruitful inquiry in this direction. In the meantime, this is a state of affairs which presents excellent opportunities for those casual coincidences so fatally attractive to undisciplined minds.

If, however, as suggested, the facts are neither so clear nor so detailed as to present a plain problem for solution, yet the occurrence of ice ages, though rather vague in time and distribution over the earth's surface, is common knowledge. Hence the alternative is to approach the problem from the astronomical end and to see where it may lead. The pioneer in this course was James Croll, and a very clear idea of the relevant conditions may be gained from Sir Robert Ball's little book, "The Cause of an Ice Age." A very important contribution to the subject from this point of view is due to Prof. C. V. L. Charlier in a publication from the Lund Observatory. His conclusion, as a matter of fact, is that accepted astronomical principles do point to the recurrence of conditions favouring an ice age at dates which he assigns. But it is of the essence of the astronomical explanation to find the

[1] "The Ice Age: its Date, Duration, and Astronomical Cause as Investigated by the late Maj.-General A. W. Drayson and recently confirmed by the Error in Timing the 1927 Solar Eclipse." Pp. 32. (Lewes, Sussex: W. E. Baxter, Ltd.) 6*d*. net.

cause in the slow changes in the eccentricity of the earth's orbit and not in large changes in the obliquity of the ecliptic. This theory also requires the ice ages in the two hemispheres to occur alternately, not simultaneously. It is hard to assess how far these acknowledged changes in the astronomical conditions have been effective, as it is to judge how far their influence may be needed to supplement all the other meteorological factors operating in past ages. If there is any reason for insisting that the ice ages have run concurrently in both hemispheres, it is far easier to find the cause in the body of the sun than in any peculiarity in the motion of the earth. H. C. P.

News and Views.

THE report of the Right Hon. W. G. A. Ormsby-Gore, M.P., Parliamentary Under-Secretary of State for the Colonies, on his visit to Malaya, Ceylon, and the Dutch Colony of Java during the year 1928, was presented to Parliament last week. This is the fourth report on Colonial development based on personal tours of the non-self-governing dependencies of the Crown for which Mr. Ormsby-Gore has been partly or wholly responsible. In 1922 he accompanied Mr. Edward Wood (now Lord Irwin) to the British West Indies and British Guiana. In 1924, Mr. J. H. Thomas (then Colonial Secretary) appointed him chairman of the Parliamentary Commission of Inquiry which visited East and Central Africa. Two years later he toured the four British Colonies in West Africa. Reports on each of these tours were presented to Parliament. Each of them is a valuable contribution to our knowledge of the countries coming within the scope of his inquiries. Considered as a whole, they constitute an almost complete summary of the facts related to the geography, history, economic development and administration of most of the countries for which Great Britain has assumed responsibility but to which it has not yet granted complete self-government. The common characteristic of the four reports is the emphasis laid upon the education, public health, and scientific and technical services as factors in the development of the resources of the tropics. Hitherto, there has been a tendency on the part of local governments to regard such services as luxuries to be afforded only in times of their prosperity. This fallacy is dealt with adequately. The scientific and technical services are shown to be the basis of economic advance. The importance of extending the public health services to prevent the enormous wastage of life and loss of physical efficiency of the peoples of the tropics is stressed, but above all it is shown that the work of such services will be largely abortive unless our subject races can appreciate what is being done and can co-operate with us. Hence it is imperative to build up greatly improved education services throughout the colonial empire.

ON his last tour, Mr. Ormsby-Gore took the opportunity courteously offered to him by the Governor-General of the Dutch East Indies to make himself acquainted with the work done by the Dutch in the colony of Java, the most densely populated part of the East Indies. He is thus able to compare Dutch with British colonial administration, and it must be confessed that the comparison does not show up British administration in a favourable light. It would appear that the Dutch administration has a greater appreciation of the beneficent influence of scientific research than we have. In the island of Java alone there is a Government central research institute at Buitenzorg and several other well-staffed and well-equipped research stations wholly maintained by the industries concerned in different parts of the island. Of the system of agricultural education in force, Mr. Ormsby-Gore speaks with the highest admiration. The public health services are also highly developed, but in this respect the British efforts to combat malaria in Malaya are warmly commended. The whole report is worthy of the closest scrutiny, and we hope to discuss it in detail in later issues of NATURE.

A MEMORANDUM has recently been issued by the New International Association for Testing Materials (N.I.A.T.M.) concerning the present position and activities of the Association and some recent decisions arrived at by the permanent committee of the Association held in Paris on June 21 last. The main object of the Association is to hold periodical congresses, but experience has shown that it is not satisfactory at a single congress to discuss subjects concerning the whole range of the testing of materials. It has therefore been decided to confine attention at each congress to a relatively small number of specially important subjects in each of the sections. On the other hand, undue specialisation in international discussions is to be avoided. To solve the task of selecting subjects for the next congress, to be held in Zurich in 1931, all participating countries were asked to forward suggestions. Sixteen countries have responded, and the outcome of their suggestions is an invitation to each country to prepare a number of preliminary summary reports on a small number of selected subjects and to appoint reporters. It is proposed to publish these preliminary reports early in 1930, in either English, French, or German. When the permanent committee receives these preliminary reports it will be in a better position to consider the final selection of subjects for the congress of 1931. The British committee, the offices of which are at 28 Victoria Street, S.W.1, is taking steps to secure widespread membership among those interested in the testing of materials, and it is anticipated that Great Britain will be adequately represented when the reports are published by the International Association.

MR. BHUDEB MOOKERJI, who has recently published the first two volumes of his work entitled "Rasa-Jala-Nidhi" or "Ocean of Indian Chemistry and Alchemy," has now issued a pamphlet entitled "Indian

Civilisation and its Antiquity" (41a Grey Street, Calcutta; price 2 rupees). He treats the subject under three heads, namely, phallism and the spread of Indian culture, the gypsies and the spread of Indian culture, and Indian chemistry and its antiquity. Mr. Mookerji has clearly lavished much effort upon his theses, but both his natural science and his etymology are, to say the least, heterodox. He says, for example, that Darwin's theory "is no longer accepted by the most distinguished of the modern scientists and philosophers," Dr. Martineau and others having proved it to be untenable "and established its utter worthlessness by a volley of irrefutable logic." As to the date of the origin of Indian civilisation, Mr. Mookerji places this about 1950 million years ago. Sir James Jeans estimates the age of the earth itself at only 50 million years more, so that we are bound to agree with Mr. Mookerji's own disarming statement that "this will appear incredible to many people." Still, in spite of exaggerations of this kind, the author has managed to make out a case for the respectable antiquity of Indian chemistry, and the pamphlet should be examined by historians of science. The sources of Rhazes' chemical knowledge are considered at some length, Mr. Mookerji giving several reasons for believing that Rhazes was indebted to the Indians for his knowledge of the chemistry of metals. If we might make a suggestion, it is that Mr. Mookerji should associate himself with some European scholar trained in the methods of historical criticism; the collaboration would probably produce interesting and valuable results.

AT a meeting of the Royal Statistical Society on Dec. 18, Mr. H. E. Soper, of the National Institute for Medical Research, read a paper on the interpretation of periodicity in disease-prevalence. Amongst the various theories put forward to account for epidemic recurrence, the most favoured presents a picture of a rise and fall in the new cases of a contagious disease as consequent upon a glut and dearth of susceptible persons; the action may be supposed to go after the manner of a pendulum, where, as the energy of flow becomes exhausted, the energy of potential activity gets stored up, to be released again when motion recommences. The stored energy is the accumulation of susceptible children, by birth. This view of the origin of the surgings of measles epidemics has been carried now a little beyond that already reached by the investigations of Sir William Hamer. A simple supposition in regard to the delayed or lapsing infectivity of an infected person, combined with a constant inflow by birth of susceptible children, leads, by invoking the statistico-chemical law of mass-action, to a periodic wave, the period of which can be interpreted. These idealised waves do not, however, give a very true replica of the curve of monthly cases of measles as presented by an actual chart. Curves very similar to the actual curves of measles cases in Glasgow would be the foreseeable consequence of combining the natural epidemic swing with a forced seasonal impulse of a certain form, the maximum of which coincides with fair truth with the time of assembly of schools after the summer vacation.

IN the early days of electrical distribution the only source of revenue was the lighting load. As the amount of plant required depends on the maximum demand at any particular time, it was necessary to instal expensive storage batteries if the capital cost was to be maintained low. The high price charged for the lighting service was due to the poor use made of the capital invested. In order, therefore, to encourage consumers to provide a load during the period when there was little demand for lighting, energy for motors and for cooking and heating was offered at a low price. Complicated tariff systems of charging have been devised with the object of encouraging consumers to use electricity at times when the demand is small. For various reasons, however, these have not proved attractive. In a paper read to the Institution of Electrical Engineers on Dec. 7 by W. Holmes, stress is laid on the importance of encouraging consumers to store thermally the energy they receive during the slack periods of the day, the house being heated and supplied with hot water continuously. Several electric companies offer to supply current for this purpose at very low rates. By suitable electric devices the current is switched on and off automatically at any desired times. Recent tests show that the electric hot-water storage tank is wonderfully efficient. A domestic thermal storage cylinder will retain its useful hot water for more than a week after the supply is switched off. A 100-gallon storage tank takes 50 units to heat it from 42° F. to 212° F., and the efficiency of the conversion from electrical energy to heat is more than 99 per cent. On a 24-hour basis the efficiency is about 94 per cent, with a capital cost of £60, and a life of above thirty years. As more than 50 per cent of the revenue of electric stations comes from the domestic load, an increased demand for electric heating would enable them to reduce substantially their charges.

THE report by a committee of the Illuminating Engineering Society on the progress made in electric lamps, which appears in the Society's *Journal* for December, is instructive, as it shows the large reductions that have been made during the last ten years in the cost of lighting. The report of the Electricity Commissioners shows that the average revenue per unit sold by supply companies for domestic purposes has fallen 33 per cent during the last ten years. The reduction of the price to the consumer is due partly to the reduction of the price per unit. For example, the Metropolitan Borough of Hampstead now charges only 3*d*. per unit for lighting. It is largely also due to reductions in the price of electric lamps and their increased efficiency. These two factors result in a great increase of candle-power hours for the same expenditure in lighting. Gas-filled lamps are now replacing the less efficient vacuum lamps, as their price is practically the same, and obscured lamps, which avoid glare, are replacing clear lamps for general lighting. Numerous small lamps are used for lighting rooms instead of a few large lamps. In particular, there is a considerable demand for lamps rated at 15 and 25 watts. In the opinion of the committee, the

further co-operation of architects in arranging the lighting of houses is desirable. Very few houses are equipped with wall plugs to which standard lamps can be connected. The committee thinks that surfaces lighted either by reflection or by transmission through diffusing media are definite architectural elements in the design of a dwelling-house.

WHEN we consider what is happening in various countries in connexion with their broadcasting services, we have reason to be satisfied with that in Great Britain. In the *Canadian Magazine* for September last appears an interesting paper by D. H. Copeland and P. Dorté entitled "A Radio Voice across the Land." They state that broadcasting in Canada is now almost in a state of chaos, and that a remedy is urgently needed. It seems that there is not a single broadcasting station in operation either in the United States or Canada which exists purely for the purpose of entertaining the public. All of them have ulterior motives, self-interest being the mainspring of the broadcasting industry. Advertising is only one of the ways in which this is expressed. An official of the National Broadcasting Company of New York has recently stated that the activities of the company have resulted in a loss of half a million dollars, and yet it is still apparently flourishing. The authors give as the reason that the company is associated with the Radio Corporation of America, and that the sale of millions of dollars' worth of apparatus has been greatly to its benefit. Advertising by radio is now a fine art, and it pays well. The public associates the name of the advertiser with the excellent entertainment he provides. The authors discuss whether it would be advisable to inaugurate a new system. They consider that the English system would be inapplicable in Canada. If a key station was made in Toronto and began its programme at eight o'clock in the evening, it would be received at Winnipeg at six o'clock, in the foothills of the Rockies at five o'clock, and on the west coast at four o'clock. A key station at Toronto would not be welcomed at Montreal. The language difficulty is a real one. Increasing the tax on broadcast reception would cause political difficulties, and the question of compensating existing broadcasting companies would be serious. They suggest having two main stations, one in eastern and one in western Canada, with an associated train of relay stations. The main difficulty is the financial one, and they state that the only solution appears to be a sound, business-like development of the advertising field.

THE December issue of the *Scientific American* contains major articles dealing with a great variety of scientific topics, from the surgery of the early Egyptians, the biology of Dominica, a study of the bladderwort, a petrified forest near San Francisco, to the practical themes of hydro-electric aqueducts of wood, the anti-efficiency influence of noise, the economic development of Canada, unique methods of dam construction, and many more. These articles are of a high standard, written for the general reader, yet comprehensive in scope, and accurate and up-to-date in their information. In addition to the longer articles there are close on a hundred minor notes containing all sorts of odds and ends of scientific news. No British magazine fills the place of the *Scientific American*, and part of its attraction lies in the number and character of its illustrations. To take the biological side alone, there are reproduced a prehistoric scene in Mongolia, by Miss Alice Woodward, illustrating some discoveries of Chapman's 1928 expedition to Central Asia; Charles Knight's new paintings, presenting the evolution of life, from the Field Museum in Chicago; photographs of petrified trees in California; of Dominican animals; of Canada's herds of bison and reindeer; and half a dozen drawings of the bladderwort. That a magazine of such a stamp can be produced for 35 cents and can boast that it is in its eighty-fourth year of issue, gives some indication of the number of Americans generally interested in scientific things.

AN exhaustive article on 'sleeping sickness' is contributed to the December number of *The Nineteenth Century* by Dr. Lyndhurst Duke, formerly chairman of the League of Nations Commission on Sleeping Sickness. This disease, which has been prevalent in Africa but is now largely controlled, is conveyed by species of biting flies, the tsetses. Dr. Duke's remarks on the relation of the big game to the disease are of special interest. As the game recedes into the wilderness the tsetse, which feeds upon it, has either to retreat with it or to adopt a new food supply. "Wherever man is seriously drawn upon by game-tsetses for food, sleeping sickness will be found; but where the primitive balance between man and the game persists, the disease is either exceedingly rare or absent altogether. . . . When man appears in sufficient force to establish himself successfully his presence inevitably drives away the game. From the biological point of view, therefore, man is not likely to serve as an essential food animal for the game-tsetse, except perhaps for relatively short periods during the retreat of the game before advancing human settlement."

IN the Hancock Museum in Newcastle and its collections, the north of England, as well as the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, possess a valuable heritage. The report of the Council for 1927–28 indicates that the Museum is appreciated locally, for close upon 22,000 persons visited it during the year, and a very encouraging response was made to the appeal of the president, Viscount Grey, for a sum of £1500, to aid in the upkeep and improvement of the building and its fittings. Actually £694 was collected, and £480 promised still remains to be garnered, but it is clear that an excellent opportunity of subscribing still awaits those who have forgotten to send their donations. The council appears to have made good use of the funds it has received, and it is encouraging to note that the membership of the Society, which, next to interest on investments, forms the mainstay of the upkeep, shows a moderate increase. The accounts printed with the report do not, curiously enough, give any statement of the capital sums from which the main revenue is derived.

THE autumn issue of *The Fight against Disease*, the quarterly journal of the Research Defence Society,

contains a review by Sir Leonard Rogers of the Report of the Vaccination Committee of 1928. This article supplies the public with a clear and reasoned statement in regard to the present-day problem of vaccination. Before the Act of 1907, which rendered it much easier to obtain exemption, somewhat more than half the children born were vaccinated. Afterward the proportion vaccinated fell, reaching a minimum of 25 per cent in 1920. With a *sixty-six fold increase* of smallpox in England and Wales in the six years to August 1927, the proportion vaccinated has risen again to 33 per cent. Smallpox is once more very prevalent (there were 15,000 cases in 1926–27 in England and Wales) and appears to be on the increase. Fortunately, the type is mild and mortality low, but, as Sir Leonard Rogers points out, the disease is subject to sudden variations in severity, and no one can foretell the continuance or otherwise of the present mild form.

PREHISTORIC toothache is yielding its secrets to modern investigation. The Museum at Los Angeles contains more than a thousand jaws of the sabre-toothed tiger from the asphalt pits of Rancho la Brea, and although few of the jaws retain their full complement of teeth, sufficient remain to yield interesting results to X-ray examination. Caries has not been found in the sabre-tooth jaw, although there are many teeth which are much worn. Pyorrhœa is probably present, but rare. Impaction, the bane of modern 'wisdom tooth' sufferers, is clearly shown in some of the jaws, as well as alveolar abscesses. Dead teeth occur, always blackened, in which the root canal is filled in, and in some cases the root has become bulbous and acquired excessive growths.

THE annual report and statement of accounts for the year 1927–28 of Livingstone College, Leyton, has been received. The College gives elementary medical instruction to missionaries in order that they may better care for their own health and that of the people among whom they work when far from qualified medical aid. The College is largely dependent upon donations and subscriptions, for students' fees do not nearly cover current expenses, and further help of this kind is urgently needed.

THE Royal College of Surgeons of England has issued a "Catalogue of Manuscripts" contained in its Library, compiled by the Librarian to the College, Mr. Victor Plarr. It records the titles or the descriptions of all written documents in the College Library, with the exception of the John Hunter Manuscripts, which have already been set out in Bailey's "List" published in 1891. The chief treasures indexed in this Catalogue are the manuscripts and letters of Clift, Cooper, Lister, Owen, Paget, Quekett, Home, and Jenner.

THE Ministry of Health has issued a memorandum on the accommodation for the sick provided at certain public schools for boys in England, compiled by Capt. W. Dalrymple-Champneys (London: H.M.S.O.). The first part of the memorandum surveys the existing sick accommodation provided at a number of well-known public schools. In the second part, the principles that should guide schools in extending existing, or providing new, accommodation are considered, with illustrative plans; this should be of considerable service to school authorities.

THE Survey of India has begun the issue of a new series of publications, which will describe the work of the Geodetic Branch, excluding the work of the Drawing Office (Survey of India: Geodetic Report, Vol. 1; Dehra Dun, 1928; six rupees, or 9*s*. 9*d*.). The geodetic work was formerly published in the series of *Records of the Survey*, which also dealt with topographical work. This first volume of the new series covers three seasons, 1922–25, but future volumes will deal with only one season's work. The volume covers a wide range of subjects—levelling, gravity and latitude, tidal observation and prediction, magnetic field and observatory work (which were much reduced during the period), and solar photography, since discontinued.

THE Buchan Prize of the Royal Meteorological Society for 1929 has been awarded to Dr. Harold Jeffreys for papers contributed to the *Quarterly Journal* of the Society during the years 1924–27 on cyclones, fluid motions produced by differences of temperature and humidity, dynamics of gepstrophic winds, and other subjects. The medal will be presented to Dr. Jeffreys at the annual meeting of the Society on Jan. 16.

THE November issue of the *British Journal of Actinotherapy* (vol. 3, No. 8) contains a full summary of the papers read at the recent International Conference on Light and Heat. There are also original contributions by Prof. Leonard Hill and Dr. Katherine Spence, abstracts from recent literature, and the first of a series of articles on the scope of actinotherapy in general practice by Dr. Annandale Troup.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A visiting teacher of house painting and decorating, at the L.C.C. Camberwell School of Arts and Crafts—The Education Officer (T.1.a.), County Hall, Westminster Bridge, S.E.1 (Jan. 4). An instrument maker at the Bradford Technical College—The Principal, Technical College, Bradford (Jan. 12). A lecturer in engineering (Grade I.) for the subjects of electrotechnics, mathematics, machine construction and drawing, etc., in the Technical College, East London, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Jan. 14). A keeper of the department of vertebrate zoology of the Liverpool Museums—The Director, Free Public Museums, William Brown Street, Liverpool (Feb. 10). An assistant lecturer in chemistry at Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11. A resident lecturer in mathematics in the Church of England Training College, York—The Principal, Church of England Training College, York. An assistant in the mechanical engineering section of the engineering department of the Municipal Technical College, Halifax—The Principal, Municipal Technical College, Halifax.

Research Items.

SKILL.—The nature of skill is discussed by Prof. T. H. Pear in the October issue of the *Journal of the National Institute of Industrial Psychology*. He begins by defining skill as an integration of well-adjusted performances, and distinguishes it from capacity and ability; it shows itself in the rapid adjustment to a changing environment and to unforeseen circumstances. Skills may be classified as (i) collections of imperfectly adapted responses, for example, much domestic work and the skill of most workers in semi-skilled trades; (ii) perfectly adapted responses which do not exhibit personality, for example, movements on parade of the perfectly drilled soldier; (iii) responses resembling habits, but less specific and automatic; (iv) responses like those in (iii) but exhibiting in their totality a pattern characteristic of the individual; (v) creative skill. Prof. Pear then discusses the possibility of the transfer of training between motor abilities. Although experiment is very difficult in this field, yet there does seem to be experimental evidence in favour of the belief that manual habits acquired during training do not transfer to other activities. Prof. Pear suggests that the reason may be because in many low-grade industrial tasks only minimal attention is required: transfer might therefore not be expected between this almost 'insulated' entity and the rest of the personality. Although the belief in transfer is widespread and the problem is an old one, yet whenever attempts have been made to obtain experimental evidence, that evidence so far has been negative.

RESPONSES OF CORALS TO ENVIRONMENT.—In the *Bernice P. Bishop Museum Bulletin No. 45*, Mr. Charles Howard Edmondson records the results of his work in a paper entitled "The Ecology of an Hawaiian Coral Reef." A section of the Waikiki Reef was specially studied, situated on the south shore of Oahu, close to the Marine Biological Laboratory of the University of Hawaii, where most of the experimental work was carried out. The responses of the corals to temperature and salinity, silt and sunshine, were studied. Rising and falling temperatures completely inhibit the feeding responses of Hawaiian shallow water corals within a few degrees of their death points. On the reversal of temperature after complete inhibition of the feeding responses, feeding is resumed much more quickly from a condition of heat paralysis than from that of cold rigor. The corals show greater resistance to decreasing than to rising temperature, although resistance varies according to the species. *Leptastrea Agassizi* and *Favia Hawaiiensis* live within the widest range of temperature, enduring extremes of both heat and cold, provided the thermal change be gradual. Exposure of 30 minutes to fresh water is fatal to nearly all species of these shallow-water corals, but by a process of gradual accommodation many can live in greatly reduced salinities, the planulæ of *Cyphastrea ocellina* being capable of enduring a 50 per cent dilution of sea water for 25 times as long as the adult. The corals adapt themselves less easily to increased salinities. Of the 23 species buried under 4 inches of sand and silt, all but 2 survived a period of 12 hours, less than 50 per cent. endured it for 24 hours, and only 3 species were alive after 5 days. It was interesting that some individuals of *Favia Hawaiiensis* and *Leptastrea Agassizi* survived after 10 days. *Favia* seems to be strongest of all and most resistant in every way. Although 50 per cent of the species die within 30 minutes if entirely removed from sea water and exposed to the direct rays of the sun during the hottest part of the day, if the bases of the colonies remain submerged those with porous skeleton may live much longer. and sunlight is important in the life of the shallow-water corals. About 50 per cent die in 18 days if cut off from direct sunlight.

MARINE OSTRACODS.—In the *Occasional Papers of the California Academy of Sciences*, **15**, August 1928, Mr. Tage Skogsberg continues his "Studies on Marine Ostracods," Part I having been published in 1920. The present part (Part 2) deals with the external morphology of the genus *Cythereis*, and describes twenty-one new species. Of these, five are from California, the remainder having been taken in the Antarctic regions by the Swedish Magellan Expedition in 1896, or by the Swedish Antarctic Expedition in 1901–03. *Cythereis* has a thick shell usually with elaborate sculpture, both shell and sculpture being very variable. It was raised from a subgenus of *Cythere* to a separate genus by Baird in 1850, the shell only being then known, and in 1865, G. O. Sars described the appendages of certain species. The present author finds that a subdivision of the genus on the basis of the shape and structure of the shell is not practicable. He therefore bases it on the structure of the appendages and of the penis, the differences in the latter organ being of importance. Three subgenera are recognised, and the descriptions of the species are detailed and elaborate. The paper is well illustrated by text figures by the author, and plates by Mr. G. Liljevall.

NEW COMMENSAL COPEPODS.—Mr. H. R. Sewell has discovered two new species of copepods living as commensals in the branchial chamber of the compound ascidian Amaroucium commonly known as 'Sea Pork.' These he describes in the *Proceedings of the United States National Museum*, vol. 73, art. 18, 1928, No. 2739. "Two New Species of Commensal Copepods from the Woods Hole Region." Both copepods belong to the Harpacticidæ, and are of the genera *Tisbe* and *Amphiascus*, and both occurred abundantly. The branchial chamber of ascidians is a favourite habitat for copepods, and probably much new material might be found if a careful search were made.

DISEASES OF *GAMMARUS*.—Dr. H. Pixell Goodrich (*Quart. Jour. Micr. Sci.*, Oct. 1928) records the occurrence in *Gammarus pulex* of *Thelohania* and *Nosema*, and gives a full account of observations on a yeast-like organism, *Cryptococcus gammari*, which may be so abundant that the blood appears almost solid and the amphipod has an opaque whitish appearance. The yeasts are ingested by phagocytes, and some of the latter secrete a chitinoid substance which envelops them. By co-operation of phagocytes, large chitinoid nodules may be formed which afterwards become dark brown and may be seen through the body wall. The chitinoid secretion of the phagocytes is not identical with true chitin of the exoskeleton. There appears to be a tendency for the yeasts to accumulate in the tips of the appendages, and such infected appendages have been observed in process of being thrown off autonomously, separation from the body taking place at a joint across a plate of chitinoid substance secreted by phagocytes which had collected in that region. A similar chitinoid substance by which wounds are closed in *Gammarus* is also a product of the leucocytes.

AGALINIS AND ALLIES IN NORTH AMERICA.—The first part of a survey by Francis W. Pennell (*Proc.*

Acad. Nat. Sci. Philadelphia, vol. 80, p. 339-449) of the North American species belonging to the hemi-parasitic Scrophulariaceous genus *Agalinis* and its allies deals with the taxonomy and distribution of seven of the nine genera. A full consideration of the phylogeny of the group based on a comparison of the several genera with a hypothetical prototype points to *Aureolaria* as approaching most nearly to the ancestral type, and *Anisantherina*, in which morphological specialisations indicate a closer affinity to a series of Old World genera than to any other American genus, as the most highly evolved. The largest genus, *Agalinis*, is counted of recent origin in the United States. The relationship of the genera shows their common origin, and the occurrence of the most primitive species in Mexico is adduced as evidence for that area being the geographical centre of the American species.

THE 'HYBRIDISATION NODULES' OF SWEDES.—On certain cultivated cruciferous plants, tumour-like outgrowths or nodules occur upon the roots which are very reminiscent of the well-known 'finger-and-toe' disease caused by *Plasmodiophora Brassicæ*, but in many of these growths no parasitic organism has been found. These excrescences frequently give rise to adventitious buds from which colourless leafy shoots push up through the soil. Such nodules were very fully discussed by Helweg in his investigations of hybrids between the swede and turnip. He concluded that the tendency to form these nodules is a hereditary character that appears in certain hybrids. Since this work such structures have been described as 'hybridisation nodules,' but this point of view must be revised in the light of A. W. Bartlett's paper in the *Transactions of the British Mycological Society*, vol. 13, Parts 3 and 4, Oct. 1928. Swedes bearing nodules of this type occur frequently in the fields around Newcastle-upon-Tyne, and under microscopic examination, whilst the nodule itself was free from any parasite, a species of *Olpidium* was found in abundance in the cells of the rootlets that were springing from the base of the nodule. Both temporary and resting sporangia of *Olpidium radicicolum* de Wildeman were usually obtained, this being the first record of this species for Great Britain. It appears to be very destructive to seedling plants of swede and turnip, and Bartlett supplies experimental evidence that it may be responsible for the appearance upon the diseased host plant of the so-called 'hybridisation nodules.'

EUCALYPTS IN CALIFORNIA.—A key by Eric Walther to the species of *Eucalyptus* grown in California has been published in the *Proceedings of the California Academy of Sciences* (4th Ser. vol. 17, No. [illegible]; 1928). "Of California's cultivated trees," the author writes, "the most striking are easily the several species of Eucalyptus. Their towering, serried ranks dominate the landscape and lend it a unique, exotic flavour totally lacking in other parts of the United States." The only species generally seen and planted to-day is *Eucalyptus globulus*, but during the boom a few years ago many other species were tried. It was apparently not realised that Australia had a great diversity of climate with fairly moist as well as dry regions, some 350 species of the genus being found there. The consequent variation in requirements of different species probably accounts for the want of success attained in California with many of the species made use of. In the author's opinion, before further planting was undertaken or new species introduced into the country, it was necessary to collect statistics regarding the species already to be found in California and their relative status. It is with this object that he undertook the work of preparing his key, and it may be conceded that he appears to have admirably succeeded in his task. Species and varieties to the number of one hundred are actually growing in California to-day, more especially in Golden Gate Park, San Francisco, on the University Campus at Berkeley, and at the former Experiment Station at Santa Monica, and elsewhere. In his paper the author has closely followed the late J. H. Maiden's comprehensive work, "A Critical Revision of the Genus *Eucalyptus*." The method adopted in the preparation of the key to the species appears simple, and should readily enable the user to run down the species he is interested in. Following the key an alphabetical list of the species is attached. The author also appends a list of the names of no less than 77 species, which he states "have been reported at various times as grown in California, or seed has been offered. No opinion can be expressed as to the correctness of these names until sufficient material for their determination becomes available." Mr. Walther may be congratulated on a paper of much general utility.

TERTIARY SHELLS FROM JAPAN.—Prof. Matajiro, Yokoyama, continues his researches into the Tertiary mollusca of Japan, and contributes two more papers to the *Journal of the Faculty of Science of the Imperial University of Tokyo* (Sect. 2, vol. 2, pt. 7). The one on the "Pliocene Shells from Hyuga," in the island of Kiushiu, deals with specimens collected in the neighbourhood of Takanabé. Upwards of a hundred species are recorded, including many that are new. These last, as well as some rare or important species, are specially described and illustrated on two plates. The other paper concerns "Neogene Shells from the Oil-field of Higashiyama," in the province of Echigo, Main Island. Nearly a hundred species are tabulated, nine being regarded as new, and figured on two plates.

A NOVEL VISCOSIMETER.—A new viscosimeter, resembling the well-known Engler pattern, is described in the *Chemiker-Zeitung* of Nov. 7, in which the special feature is a double system of corrugated radiator plates attached radially to the inner wall of the outer vessel and to the outer wall of the inner vessel respectively. By means of this device, uniform distribution of heat is secured without the use of a stirrer, and it is claimed that very satisfactory tests extending over a number of years have been made. The outer bath is protected from rapid loss of heat by radiation by means of an asbestos covering and a double-walled cover is provided. Other fittings include a levelling device, a special outlet valve for the oil, and a stopcock by means of which the heating-bath can be drained. The readings are the same as with Engler's viscosimeter, so that no correction is required. The apparatus is supplied by the firm Emil Dittmar and Vierth of Hamburg, and can be adapted for heating by gas or electricity. Viscosimeters of older pattern can also be fitted with the new radiators.

THE SPECTRA OF HAFNIUM.—A large gap in descriptive spectroscopy has been filled through the publication by W. F. Meggers of a list of wave-lengths of some fifteen hundred lines of hafnium. The investigation was made at the United States Bureau of Standards, and is described in the issue of the Bureau's *Journal of Research* for August. The purest available samples of hafnium salts, presented by Profs. Bohr and Hevesy, were used, but the spectroscopic examination showed that even these were considerably contaminated, in particular with zirconium and columbium. In spite of this, however, and the added difficulty of unravelling the arc lines from a prominent band spectrum, presumed to be that of an oxide, a satisfactory separation of the lines was made into those originating with the neutral atom (Hf. I), and

with the singly charged ion (Hf. II), whilst some lines in the ultra-violet probably came from multiply charged ions (Hf. III or Hf. IV). The *raie ultime* of the neutral atom has been tentatively identified as a line in the violet at 4093 A., but it does not appear amongst Rowland's list of the solar Fraunhofer lines, although there are some lines of the first spark spectrum amongst the latter. No analysis of these spectra has yet been effected, although it is stated that this is being attempted, and since on Hund's theory the fundamental term of the spectrum of the neutral atom is only an F triplet, it is to be anticipated that the problem will not present any insuperable difficulties.

THE STRUCTURE OF MOLECULES.—The fourth of Dr. F. Hund's papers on the significance of molecular spectra has appeared in the issue of the *Zeitschrift für Physik* of Nov. 12. The results which he has obtained are closely similar to those recently published by Prof. Mulliken, the electronic states of a number of light diatomic molecules being deduced by application of the same principles that have been used with such conspicuous success for single atoms, but Dr. Hund's analysis is rather more general than Prof. Mulliken's, and he has also added a few remarks on the structure of polyatomic molecules. When there are more than two nuclei in the compound, he has shown that in all probability not more than two electrons can occupy each quantum path, although with diatomic molecules as many as four electrons may be equivalent in this respect. He has also pointed out that the tendency of some atoms and radicles to form chains —for example, atomic oxygen in the oxy-acids of chlorine, and the group CH_2 in numerous organic compounds—is closely connected with the fact that the atom or group contains eight electrons, which tends to preserve a general similarity of the electronic grouping in the molecule to that met with in the inert gases. This, again, would indicate that such compounds should be diamagnetic, which seems usually to be the case, although, as is emphasised, the occurrence of diamagnetism is not an infallible criterion for the existence of these particular arrangements of electrons. Some of the ideas which are being developed by Dr. Hund and Prof. Mulliken in this connexion are admittedly not new, but they do now take on the aspect of logical consequences of the fundamental concepts of the quantum theory.

CONSTANTS OF AN ELECTROMAGNETIC OSCILLOGRAPH.—An oscillograph records photographically the wave form of the electric currents or the discharges that pass through it. They are of two types: first, the electronic or cathode ray type; and secondly, the electromagnetic oscillograph, under which heading is included also the electrothermic instruments. In a paper communicated to Volume 67 of the *Proceedings of the American Philosophical Society*, Dr. A. E. Kennelly describes a new method for determining the constants of the electromagnetic instrument. He discusses mainly its performance when used to record alternating currents which have reached the steady stage. Owing to the effects of inertia in the moving parts of the vibrator, the response of an oscillograph to alternating current impulses of different frequencies is not the same. When an oscillogram is analysed into a series of Fourier components of different frequencies, it is known that a correction factor should be applied to each component to eliminate the error due to inertia. The magnitudes of the various corrections depend on the frequency. The author has shown in his book on "Electrical Vibration Instruments" that if the resonant frequency of an oscillograph vibrator could be identified experimentally and also its 'quadrantal frequencies,' then the correction factor for any recorded frequency could be evaluated. Recently, however, improved methods of supplying a wide range of alternating current frequencies to an oscillograph for testing purposes have become available, and this simplifies the determination of the correction factors: The behaviour of an oscillograph at all frequencies is completely specified when its resonant frequency, its 'specific deflection,' and the 'bluntness of the resonance' are known. The 'specific deflection' is the deflection per unit of testing current taken at some convenient frequency of reference, such as 60. The 'bluntness of resonance' is simply the reciprocal of the sharpness. The method given is mainly useful when the time which the observer can devote to the calibration of the instrument is limited.

ACTIVE NITROGEN.—The relation of the formation of iron nitride in the iron arc to the presence of active nitrogen is discussed by E. J. B. Willey in the *Journal of the Chemical Society* for November. The amount of nitride present in the arc appears to decrease from 12-15 per cent. at the metal-vapour zone to about 6-8 per cent. at the outer edge of the arc. Examination of the arc light by means of a Hilger spectrometer failed to detect the presence of the nitrogen afterglow spectrum. It is suggested that either the reaction between the iron vapour and the active nitrogen is so rapid that the concentration of the latter remains exceedingly low, or that the chemically active nitrogen is present in a non-luminous form.

CRYSTAL STRUCTURE OF SILVER SUBFLUORIDE.—Sub-compounds are of interest chiefly because of the peculiar valency relationships involved. The crystal structure of one of the best defined of these compounds, silver subfluoride, Ag_2F, is described by H. Terrey and H. Diamond in the *Journal of the Chemical Society* for October. The substance was prepared by the electrolysis of a concentrated solution of silver fluoride at 60°, and was examined by the power method. The structure appears to resemble that of cadmium iodide, and the density indicated that there is only one molecule in the unit cell, which is hexagonal and has the dimensions, $a = 2{\cdot}989$ A. and $c = 5{\cdot}710$ A. The authors suggest that perhaps in the molecule of subfluoride two silver atoms partly share their uncompleted electron rings, leaving between them the one electron required by the fluorine atom. Such a hypothesis affords some explanation of the metallic properties of silver subfluoride.

THE CO-ORDINATION NUMBER OF COBALT.—According to Sidgwick, elements up to the end of the first long period in the periodic classification do not have a covalency higher than six. This rule appeared to be violated by the existence of a cobalt allylamine, prepared by Pieroni and Pinotti (1915), in which the cobalt apparently had a co-ordination number of eight. The *Journal of the Chemical Society* for October contains an account of the re-investigation of this compound by W. R. Bucknall and W. Wardlaw. Their analysis differs considerably from that of Pieroni and Pinotti in the value for cobalt, and they have carried out molecular weight and conductivity measurements. Bucknall and Wardlaw conclude that the compound probably has the formula $[3al\,.\,Co \begin{smallmatrix} \diagup O_2 \diagdown \\ -OH- \\ \diagdown OH \diagup \end{smallmatrix} Co\,.\,3al]Cl_3$, thus assigning the normal covalency of six to the cobalt. A second allylamine, also prepared previously, was examined, and this is believed to be

$$[3al\,.\,Co \begin{smallmatrix} \diagup O_2 \diagdown \\ -OH- \\ \diagdown OH \diagup \end{smallmatrix} Co\,.\,3al](NO_3)_3.$$

METALLIC CORROSION.—G. D. Bengough, J. M. Stuart, and A. R. Lee have given an account of some further experiments which they have made on the etching of zinc by potassium chloride, in the presence of oxygen, in which they have found, *inter alia*, that hydrogen may be formed in the reaction under some conditions (*Proc. Roy. Soc.*, A, 121, Nov. 1). They have now collected a considerable body of results, most of which they have summarised in a convenient tabular form, and they conclude that these support quantitatively the newer version of the electrolytic theory of corrosion. An important practical question that they have raised is that of the time-period to be adopted in carrying out laboratory tests to determine relative corrodibility. The relation between the amount of corrosion and the time is usually not linear, and the reduction of results to any such form as a weight of metal corroded per unit area per day is thus not very significant. The convection of the etching fluid is also not usually properly controlled, and this, in their opinion, is one of the chief reasons why tests of this kind are not reproducible. Their remarks in this connexion should, however, apply strictly only to cases in which the oxygen exerts the main control; the formation of films, which is in other cases at least as important, is to be dealt with in a later paper. These researches have been carried out for the Corrosion of Metals Research Committee of the Department of Scientific and Industrial Research.

PROPERTIES OF PERMINVARS.—When iron, nickel, and cobalt are melted together in certain proportions the resultant alloys, after definite heat treatments, are found to possess very unusual magnetic properties. A group of these nickel-iron-cobalt alloys is found to possess practically constant permeabilities when subjected to moderate magnetising forces. The constancy is better than that of soft iron, although the initial permeability is very much greater. In the *Bell Laboratories Record* for September, G. W. Elmen describes the discovery of these alloys and points out some of their peculiarities. When the hysteresis loop for a sample of these alloys is carried up to very intense magnetisation, it is found to have a characteristic but unusual shape. It is something like an ordinary hysteresis loop with the two sides of the loop touching at the centre, so that there is no remanence and no coercive force. The characteristics of these alloys are unique, and it is proposed to call them perminvars, a name constructed from 'permeability' and 'invariable.' The perminvar properties are obtained by heat treatment. The alloys are heated at 1000° C. for a short time and then cooled. It is found that the rate of cooling from 600° C. to 400° C. determines the degree of the development of the characteristic properties. The best results are obtained when the alloy is cooled through this range in five hours. When the cooling is rapid the perminvar properties disappear altogether. The results obtained with a 45 per cent nickel, 25 per cent cobalt, and 30 per cent iron alloy specially heat-treated, are given. For magnetising forces not exceeding 1·7 gauss the permeability is practically constant, the variations being well within one per cent. This is a very remarkable result, as the permeability is nearly 500, which is nearly double that of iron for low magnetising forces. When armco iron was subjected to the same range of magnetising forces, its permeability increased from 250 to a maximum of 7000, which it had when the force was 1·3 gauss. It then decreased to 6000.

POWER UNITS IN AGRICULTURE.—The report of the conference held at Rothamsted on power for cultivation and haulage on the farm, held in 1928, has now been published (London: Ernest Benn, Ltd. 2*s*. 6*d*.). It consists of six papers by leading experts, an account of the discussion, and a résumé by Dr. B. A. Keen. There are five forms of power in use for agricultural purposes in addition to that obtained by horses, namely, steam, gas, petrol, low-grade fuel, and electricity. In the near future there seems little likelihood of the horse being replaced by mechanical forms of power, owing to its great adaptibility to all kinds of work. When steam power is used it is generally obtained by hiring from contractors. The development of steam wagons for general road haulage has not yet spread to agriculture. A few stationary gas engines are employed, but their number is decreasing. Petrol engines are those most commonly employed in farm work, and recent types are very economical compared with those in use before the War. A successful form of light tractor using a Diesel-type engine consuming low-grade fuel has been introduced. The electric motor is by far the simplest form of prime mover, only the two main bearings and the brush holders requiring occasional attention. The cable that has to be wound and unwound as the implement passes across the field is a drawback. The petrol-electric system is worthy of serious consideration, as it combines the advantages of electric drive with freedom from fixed cables. Increased speed of work is of great use for cultivation as well as in connexion with road haulage. Owing to the great developments in the imported meat trade, the policy of laying down land to grass in periods of agricultural depression may need revision. An alternative is the intensification of arable farming by paying special attention to vegetable products of a semi market-garden type. This would necessitate an extended use of power for farming methods.

ELECTRIC KILNS FOR CERAMICS.—Experiments on electrically heated kilns for use in the ceramic industries have been in progress for the last ten years, but it is only recently that improvements have been made which promise that they will be useful in commerce. A reduction in the price of electricity would widely extend its use for furnaces. The great purity of the atmosphere in an electric furnace makes it ideal for decorated pottery. A normal coal-fired muffle furnace requires about 19 hours before a satisfactory result can be obtained. According to S. R. Hind in *World Power* for December, better results can be obtained in half the time by an electric furnace. The exceptional accuracy with which the temperature of the furnace can be controlled and what may be called the 'availability' of the energy as compared with that obtained from fuels, leads to excellent results. In British potteries the technique associated with the heat treatment of the higher grades of clay wares has grown up almost entirely by rule-of-thumb trials. The results obtained in this way have been transmitted traditionally amongst a special privileged class of craftsmen. The ends aimed at were to use solid fuel to the best advantage and to reduce the cost of the necessary labour. Hence for high temperature work very large ovens were used. For the manufacture, however, of the insulators used for the 'grid' electrical transmission scheme, which is being constructed in Great Britain, it is found that very steady heating is required. The specifications for these insulators are very strict. The porosity, for example, must be less than a tenth of one per cent. They have to withstand a combination of very severe electrical and mechanical stresses. Sufficient time, therefore, must be allowed for the temperature to become uniform throughout the thickness of the ware. Vitrification must proceed uniformly and the recrystallisations and conversion of its constituents must proceed evenly and without strain. Hence the temperature of the furnace has to be closely regulated.

Sugar Beet Growing in East Anglia.[1]

DESPITE the fact that there were 222,000 acres under sugar beet in Great Britain in 1927, the crop must still be regarded as being on trial. The rapid increase in its acreage is due in large part to the action of the temporary subsidy on home-grown sugar, and we have still to learn whether it will take its place as a considerable factor in British agriculture of the future. The amount of trustworthy information about the crop in its various aspects is still quite small, and therefore the recently published work on the sugar beet crop in the eastern counties of England during 1927 from the Farm Economics Branch of the Department of Agriculture of the University of Cambridge has an added value.

The conduct of a close investigation, covering 100 farms and some 2300 acres, situated in eleven counties, must always be a matter which requires daring in conception and steady perseverance in execution. The Cambridge team has attacked the business in a pioneering spirit, and where the standard methods of agricultural costing have not met new requirements, they have been modified to suit the occasion. The results, which form the investigation of what is described as the "largest sample that has ever been made," are bound to be interesting, and both interest and confidence increase when it is realised that each of the stages of the work has been handled with care and common sense.

The final tables upon which the whole of the detailed work converges show that the average yield obtained on the land under consideration was 7·711 tons per acre of washed beet, and that the average net cost of this to the grower was £2 : 4 : 5½ per ton, or £17 : 2 : 8¾ per acre, and this is worked down to a standard error of mean net cost of only 5*s*. 6*d*. per acre. The extremes of cost over the 182 fields involved, situated on many different soils vary from £10 per acre to £31 per acre, and these point to the fact that the individual accounts in the appendices should be studied in conjunction with the averages before conclusions are drawn about any one type of farm or class of soil as being suitable for sugar beet.

From the climatic point of view 1927 was not a good season for sugar beet, and 7·711 tons per acre is not a good yield, though it exceeds the national average for that year by about 1 ton. Despite this, the average net profit shown in the investigation was £4 : 4 : 1 per acre, or 10*s*. 10¾*d*. per ton. Of this net profit, by far the larger part, £3 : 18 : 7½, is represented by credits to the crop for tops, residual value of manures, and extra cultivations, and in this light the crop appears as one which enables the arable farmer to get his expensive cleaning shift for nothing, rather than as one which brings a large cash supplement to his bank account. The main factor in deciding the cost per ton of washed beet on the various holdings involved has been, of course, the yield per acre, and the first result of this investigation is to point to the need for higher average yields if sugar beet is to flourish as a real cash crop, and not to languish as a cleaning crop rather less expensive than swedes or mangolds.

The design of the investigation has allowed for the examination of a number of the steps taken by growers in producing the crop, and some figures are produced which throw a new and sometimes surprising light on the value of such things as farmyard manure, subsoiling, rates of seeding, and field spacing. These figures, while they cannot be considered as the basis for final dicta, are of real interest to growers of the crop.

It is satisfactory to know that the investigation is being continued in the present year, and that there will be a second set of results to test and add value to those already published.

C. H.

[1] "Sugar Beet in the Eastern Counties, 1927: being an Investigation into the Financial Results obtained on One Hundred Farms, and some of the Factors influencing them." By R. McG. Carslaw, C. Burgess, G. Ll. Rogers. (University of Cambridge, Department of Agriculture, Farm Economics Branch, Report No. 9.) Pp. xii + 94. (Cambridge: W. Heffer and Sons, Ltd., 1928.) 3*s*. net.

Salmon Disease.

FURUNCULOSIS, an epizootic disease causing considerable mortality among salmon and trout from time to time, has only recently spread into Scotland and the north of England, though it was known in central Europe so long ago as 1894. It has been investigated independently in Great Britain by Dr. F. H. A. Clayton (*Rep. Dove Marine Lab.*, New Series, **16**, p. 49; 1927) and Miss Isobel J. F. Williamson (Fishery Board for Scotland, *Salmon Fisheries*, No. 5, 1928. H.M. Stationery Office, 1*s*. 3*d*. net.)

Miss Williamson finds that the characteristic superficial lesions ('furuncles') are areas of subcutaneous necrosis, not comparable to the pus-producing lesions of warm-blooded vertebrates. Both authors obtained similar results by inoculation of experimental animals, such as brown trout, salmon and sea-trout smolts, blenny and plaice (Clayton), frogs, trout, and other fishes (Williamson). Inoculation through the open mouth and direct application of the culture to scarified areas of skin proved pathogenic to trout and other species, which died in one to four weeks, and the causative bacillus, *B. salmonicida* Emmerlich and Weibel, was recovered from the heart-blood. Characteristic symptoms were observed, including the furuncles and the loss of orientation shortly before death (Williamson). Infection of the water was longer in taking effect. Both authors infected salt-water fish, and whereas Miss Williamson recovered *B. salmonicida* in a Zoarces which died from other causes, Dr. Clayton found the disease lethal to the same fish.

Dr. Clayton makes an important contribution to the subject by his discovery that one of two codling, internally inoculated, harboured the bacillus for at least a month in perfect health, and points out that an immune or partially immune sea-going salmon might act as a carrier, and introduce the disease into other rivers, since it is now known that the salmon does not always return to its native river to spawn. In culture the organism appears to be less viable in salt than in fresh water, and Miss Williamson's experiments with polluted natural waters from various sources have failed to reveal any connexion between these conditions and the spread of the disease. Her view is shared by Dr. Clayton, and both point out its common occurrence in rivers like the Coquet and upper tributaries of the Tay, where there could be no question of pollution. That furunculosis is spread by immune individuals or 'carriers' seems to be the most probable explanation.

Examinations and Ability.

IN an examination in any school subject, the maximum mark being 100, different distributions of the candidates among the hundred-and-one possible marks or percentiles are possible; different distributions are in fact found to result from two examinations of the same pupils in the same subject. The views expressed by Mr. B. C. Wallis in a privately printed pamphlet, "Mass Methods of Examining Children," a copy of which has reached us, may be stated as three propositions, of which the first two are: (1) an examination mark is not in general a measure of the ability of the candidate, but merely a symbol by means of which the candidate's rank in order of merit can be determined; (2) in order to obtain a mark that is a measure of the candidate's ability the examiner's marks must be adjusted to an appropriate standard distribution, the same for all cases.

Mr. Wallis reasons the matter cogently and with many illustrations of the effects of different distributions. He has in mind one of the school certificate examinations. If the one in question is that in which the percentage of passes varies throughout the range between 30 and 40, his complaint is thoroughly justified. When an examination deals with thousands of candidates, the constancy of the average candidate is assured and variation of the percentage of passes through such a range is inevitably due to variation in the standard of the questions and of the valuing.

Mr. Wallis's third proposition is that the standard distribution to which every examiner's marks are to be adjusted is the straight line distribution, on which there are the same number of candidates at every percentile. The only alternative with which he compares the straight line distribution is the cocked-hat distribution. The cocked-hat distribution, however, goes to infinity in both directions, and is unsuitable for a phenomenon that stops abruptly at both ends like examination marks. Suitable distribution curves for such phenomena are well known and may be found in Palin Elderton's "Frequency Curves." One type is the straight line; in another type the candidates are bunched at the two ends or at one end; in a third type they are bunched somewhere about the middle.

Mr. Wallis says truly that it has never been proved that marks on the cocked-hat distribution are measures of ability. It is equally true that it has never been proved that marks on the straight line distribution are measures of ability. The matter cannot be put to the test directly until precise information is available as to what the school aims at doing and as to what the examination aims at testing. But many investigations have been carried out in the Galton Eugenics Laboratory on physical, intellectual, and temperamental qualities, and the distribution is found in general to be bunched about the middle. Moreover, every examiner does his imperfect best to make his marks measure ability, and it can scarcely be a mere coincidence that in statistics kept for half a century the distributions have, with the rarest exceptions, been found to bunch about the middle.

Accordingly, while in complete agreement with Mr. Wallis in the view that examination marks ought to be adjusted to a chosen standard distribution, we are of opinion that a distribution bunched somewhat at the middle will furnish a truer measure of ability than the straight line distribution.

Potential Gradient at Great Heights.

IN June 1926, M. P. Idrac published in the *Comptes rendus* of the Paris Academy of Sciences a short description of the apparatus which had been devised for recording potential gradient at great heights and gave some account of the results which had been obtained.

Further details are now available in a paper which has been published by the Office National Météorologique de France. The system adopted was invented by M. l'Abbé P. Lejay, and depends on the use of a valve with four electrodes.

The whole apparatus is very compact. A balloon two metres in diameter can carry up the electrograph as well as a barothermograph. In practice two smaller balloons tied together are used instead of one large one. The apparatus hangs about twelve metres below the balloon, and there are at different levels two fuses, one of which is connected to the filament, the other to the grid of the valve. The difference of potential between these fuses determines the strength of the current flowing through the valve. This current passes through a recording milliammeter, the readings of which can be interpreted as giving the potential gradient. To allow for recording negative potential gradient, considerable grid bias is necessary, but to save weight the grid bias battery is frequently dispensed with and some of the records fail where they should show negative gradients. Between May 1926 and the end of 1927 there were 60 ascents, of which 44 have given useful results. These are all set out diagrammatically in the paper. The fluctuations in potential gradient in the various cases are remarkable, but some good records were obtained both for the ascent and the descent of the balloon, and the agreement in the curves inspires confidence in the system.

With so much variation from day to day it is not surprising that the averages given for the three groups, ascents made by night, in the morning, and in the afternoon are not very smooth. According to the averages for the afternoon, the potential gradient over Trappes at a height of 2 km. is 43 volts per metre. The gradient falls off to 11 volts per metre at 5 km., but at 7 km. it is 25 volts per metre, and at 9 km. it is 30 volts per metre. There is a sudden drop, presumably on entering the stratosphere, to 2 volts per metre, another rise begins at 12½ km. and a maximum of 16 volts per metre occurs at 14 km. The diminution to practically zero gradient at 20 km. seems to be based on one record only. If we may interpret the observations in the light of Coulomb's Law it appears that in the afternoon the air is positively charged up to 5 km., negatively charged between 5 km. and 9 km. There is a considerable positive charge just below the stratosphere. The stratification by night and in the morning is found to be somewhat simpler.

As M. Idrac emphasises, more observations are required before trustworthy generalisation can be made. It is to be hoped that the new line of research will be followed up in many parts of the world. It is only by learning about the conditions in the upper air that we can consolidate our knowledge of the processes of atmospheric electricity.

The Vegetation of Kamchatka.[1]

THE vegetation and flora of Kamchatka are still very little known, and the book by V. L. Komarov, recently published by the Russian Academy of Sciences, is therefore of considerable interest. The flora of Kamchatka may be divided into three groups: (1) That of central Kamchatka, with its spruce and larch forests; (2) flora typical of the peninsula, for the greater part composed of *Betula Ermani*; (3) the subalpine and alpine flora. The variety of species is limited, phanerogamous plants and filicoids together scarcely exceeding 780 species. This peculiarity is chiefly due to severe climate and frequent volcanic activity.

The main portion of Kamchatka is stocked with plants of alpine and subalpine character, but the vegetation of the plains, represented by coniferous forests, may be found around the valley of Kamchatka River. Larch groves consisting of *Larix dahurica* Turcz. are replaced by forests of *Picea ajanensis* Fischer. The larch attains its maximum growth in the driest parts of river alluviums. The spruce of Ajan prefers mountain slopes, and is frequently interspersed with aspen and white birch; its boundaries are not known. The larch emerges from the valley in three places only, namely, at Kronotzk Lake, in the region of the lower course of the Kamchatka River, and near the foot of Glavny Khrebet. *Populus tremula* L. is found with the above-mentioned species, but its distribution is strictly confined to the central region. Erman birch composes the rest of the Kamchatka forests. It grows on the borders of forests near the river of Three Sisters and spreads as far as the Isle of Koraginsk.

The wide-spreading crowns of the birches prevent them from growing close together, leaving sufficient room for development of a dense carpet of herbaceous plants. The normal growth of Erman birch is impeded by heavy snowfalls. It avoids alluvial soils, and is invariably found near the sea-shores, where it suffers from wind, frequently forming impassable thickets. The white birch, similar to the Japanese variety (*Betula japonica* Sieb. var. *kamtschatica* (Rgl.) H. Wiucl.), grows in alluvial soils and is an integral item of mixed coniferous forests.

The subordinate part of the Kamchatka forests consists of the bird-cherry, the sorb, the hawthorn (*Cratægus chlorosarca* Max.), while the riverside forests are composed of *Alnus hirsuta* Turcz., *Populus suaveolens* Fisch., *Salix macrolepis* Turcz., *S. sachalinensis* Fr. Schmidt, and *S. Gmelini* Pall.

Shrubby brushes are also widely distributed in Kamchatka. The first place among them is occupied by alder plots (*Alnus fruticosa* Rupr. var. *Kamtschatica* Rgl.). Its branches are usually pressed to the ground, forming densely interlaced thickets. *Pinus pumila* Rgl. occupies the second place. It grows in the same manner as the alder, attaining the height of 5 metres in the forests, and decreasing to 1 metre on mountain ridges. The third place is occupied by *Sorbus sambricifolia* Roem., which forms close walls and attains its maximum height at the upper border of the mountain forests. *Spiræa Salicifolia* L. and *Rosa amblyotis* Cam. are frequently found in large river valleys.

The following shrubs are found growing in groups: (1) *Lonicera cærulea edulis* Turcz., (2) *Spiræa betulifolia* Pall., and *S. media* Schmidt, (3) *Salix fuscescens*, *S. oblongifolia*, *S. Pallasii* Anderss., (4) *Lonicera chamissoi* Bge., (5) and, more rarely, *Daphne kamtschatica* Max. Dwarf forms of willow are encountered in the Alpine region; amongst them are *S. berberifolia* Pall., *S. arctica* Pall., *S. chamissonis* Andrss., *S. cuneata* Turcz., and *S. reticulata* L. var. *orbicularis* Andrss.

The herbaceous plants *Filipendula*, *Heracleum dulce* Fisch., *Senecio palmatus* Pall., and *Urtica angustifolia* Fisch. develop fully, reaching great heights in the vicinity of river banks. *Angelica ursina* Max. is found on dry meadows. The *Calamagrostis Langsdorffii* Trin. are the most developed of the gramineous herbs, but *Spiræa salicifolia* L. and *Carex Lyngbyei* are also abundant. Groups of *Fritillaria kamtschatcensis* Gawl. are found in dry meadows, and *Lilium avenacium* Fisch. at the outskirts of forests.

The prevailing species of the alpine flora are the following: *Arnica*, *Diapensia*, *Hierochlœ*, *Papaver*, *Alsine*, *Dryas*, *Pedicularis*, *Saxifraga*, *Rhododendron kamtschaticum* Pall., *Phyllodoce*, *Bryanthus*, *Loiseleuria procumbens* Desf., and *Cassiope lycopodioides* G.

Though from a botanical point of view Kamchatka may be considered as an island, it has no sharply defined endemic vegetation. The flora is far from being unique, consisting mainly of circumpolar plants. Violent volcanic catastrophes and ice masses have displaced and deteriorated the ancient vegetation, which united the flora of Kamchatka with the neighbouring parts of America and Japan. The coniferous forests of the centre are the sole remains of floristic antiquity. After the glacial period Kamchatka was stocked with Arctic elements from Anadyr, or from shores which were elutriated by sea currents. Plants migrated from the continent are found on the north-west shore, while plants carried over from Japan are encountered in the southern part of the peninsula. Scarcely more than 50 species, or 6 per cent of the whole flora, are typical or endemic species, which are peculiar to Kamchatka. About 380 species, or 50 per cent of the whole flora, are represented by species bearing close affinities to European plants. There are only 25 species, or 3·73 per cent, which are found in America. These are confined to the narrow strip of the Bering Sea shores. The number of species indigenous to the country is 752: *Filicineæ* 42, *Coniferæ* 5, *Monocotyledons* 240, *Archichlamideæ* 291, *Metachlamydeæ* 174. The remaining 40 per cent are those of eastern Asia. *Cyperaceæ* and *Compositæ* occupy the first and the third places, respectively, among the largest of families. This obviously indicates the comparatively great marshiness of the country.

The book contains a full list of the plants of Kamchatka, with keys for their determination and specific diagnoses.

[1] "Flora Peninsulæ Kamtschatka." By V. L. Komarov. Pp. 339 + 13 plates. (Leningrad: Academy of Sciences, 1927.)

Triangulation of France.[1]

THE old triangulation of France is considered as having been begun in 1811 by a body of military surveyors known as 'Ingénieurs Géographes.' The work, however, was really a continuation of that executed by Delambre and Mechain between 1792 and 1801, when the old Arc of Meridian was measured from Dunkirk to Barcelona. Under Brousseaud, Bonne, Hossard, Levret, Perrier, and other 'Ingénieurs' of the Dépôt de la Guerre, the triangulation was carried over France and linked with the surveys of Italy, Belgium, Britain, and Germany. The origin for latitudes, longitudes, and azimuth was taken at the Panthéon, whence geodetic latitudes and longitudes

[1] *Bulletin Géodésique*, No. 12 and No. 16, "Formules pratiques pour le calcul des coordonnées géodésiques." By Lieut.-Col. E. Benoit. (Paris: J. Hermann; 1926 and 1927.)

were computed throughout the country from the sides and angles of the triangulation.

Puissant, following Legendre, had derived expansions for working up these extended latitudes, longitudes, and azimuths, but unfortunately the engineers had limited the expansions to terms of the second order. The result was that the errors due to computation alone frequently amounted to 0·03″, say 1 metre.

The object of the methods set out in the two numbers of the *Bulletin Géodésique* is to bring these old formulæ of the engineers into line with modern accuracy. In a preface by General Perrier it appears that the methods were devised at Saigon in 1905 by Lieut.-Col. E. Benoit. The latter has not only modified the old spheroidal factors, always tabulated, but has also introduced corrections to the terms last computed, so as to take the terms of the third order into the reckoning. These corrections are calculated by the aid of two supplementary tables, II. and III. The result is that the maximum error in latitudes below 70° is reduced to 0·002″, say 2½ inches, even when the side of the triangulation is 60 miles in length.

In *Bulletin* No. 12 the methods of derivation of the formulæ are described and the spheroidal factors are tabulated for every 10 sexagesimal minutes of the quadrant. In No. 16 the same factors are shown on the centesimal system, the figure of the earth employed being that of Hayford. The author is to be congratulated on the success of his accomplishment; the formulæ now rank with others of modern times.

G. T. McC.

University and Educational Intelligence.

LONDON.—The Rhodes Trustees have made a donation of £5000 to the fund which Mr. F. C. Goodenough is raising in order to build a Hall of Residence for Overseas and British Students at the University, and have provisionally undertaken to set aside a sum of £5000 towards the building of a Students' Union.

The following doctorates have been conferred: D.Sc. in medical statistics on Mr. Major Greenwood, University professor of epidemiology and vital statistics, for a thesis entitled "Laws of Mortality from the Biological Point of View"; D.Sc. (engineering) on Mr. J. N. Long (Imperial College, City and Guilds College) for a thesis entitled "Heat Transmission: A Series of Investigations into the Phenomenon of Heat Flow in an Air Stream, in relation to some of its Industrial Applications."

Prof. L. N. G. Filon has been appointed for a period of five years to be Director of the University Observatory, and Mr. C. C. L. Gregory to be Wilson observer at the Observatory.

WE have received from the Rhodes Trust a copy of a statement for the academic year 1927–28 regarding the Rhodes scholarships. The number of scholars regularly resident at Oxford during the year was 187, namely, 94 from the British Empire and 93 from the United States of America. Natural science and medicine claimed 43 of them, mathematics 7, and economics 7. Among distinctions won by former Rhodes scholars, mention is made of the following appointments: J. J. Tigert (Tennessee), lately United States Commissioner of Education, to be president of the University of Florida; S. K. Hornbeck (Colorado) to be Chief of the Division of Far Eastern Affairs in the Department of State, Washington; and P. H. Rogers (New South Wales) to be a Justice of the Supreme Court of New South Wales. Thirty-one of the Rhodes scholars represented Oxford against Cambridge in athletic contests, and three represented their Dominions at the Olympic games. Of 37 books known to have been published during the year by Rhodes scholars, twenty-five were published in the United States, eleven in the British Empire, and one in Germany. Only three were on scientific subjects.

SCIENCE teaching in rural secondary schools in America is criticised by the professor of rural education, Cornell University, in an article published in the September number of *School Life*, an official organ of the United States Bureau of Education. Teachers have, in general, been too intent upon "drill in dry facts and principles of a formal science which creates no enthusiasms and which should follow an interesting initiation." There has been a general disregard of the connexions between the science studied and the economic, social, æsthetic, and other aspects of rural life, the courses of study and text-books having been planned and written largely from the point of view of the city and its institutions. In the same number of *School Life* another aspect of science teaching is discussed in an article on "Social Hygiene Work by the Parent Teacher Associations." The value of the study of biology has lately been emphasised by the National Congress of Parents and Teachers and American Social Hygiene Association. These bodies are actively engaged in promoting the systematic instruction of children in the facts of human reproduction, and a pamphlet has just been issued by them in which these facts are presented in such a way as to help parents to take their proper share in this task, for which, moreover, parent-teacher study groups are organised for reading and monthly discussions on such topics as "The Way Life Begins," "Sex and Social Health," etc.

SPEAKING of "Science, Industry, and Humanism," in the Taylorian Lecture, 1928 (Oxford: Clarendon Press, 1928), Dr. Abraham Flexner enlarged upon the peculiar function of humanism as the assessor of values. Science and industry have in the past two hundred years transformed the face of the civilised world and profoundly modified human conceptions of the past, present, and future, but neither science nor industry, as such, is concerned to consider in respect of any of its doings, whether it makes for the weal or the woe of mankind. It is for the humanist to elaborate a rational system of values appropriate to the conditions not only of past ages but also of to-day and to-morrow, and thus to influence the direction of human development; and in proportion to the magnitude of the changes wrought by science and industry is humanism's burden heavy. Science has vastly enlarged the scope of human knowledge, human effort, human thought, human imagination: it has given wings to the human spirit. But it ministers also with absolute impartiality to the worst that is within us. Humanism must, it is true, use scientific method in procuring data, in generalising and in interpreting, and in the last century the scientific side of humanistic studies has been strongly emphasised, but the attitude of detachment and indifference proper and necessary to science, must give place in the humanist to the attempt to see things in perspective, to measure, albeit tentatively, the works and doings of the human spirit, scientific, practical, and humanistic as well. The humanist is the custodian of the human ideals evolved through the ages, and he fails to rise to the height of his opportunity if he shrinks from attempting to appreciate the situation of the world of to-day.

Calendar of Customs and Festivals.

ADDENDA. **December 24.**

A rite practised on Christmas Eve as well as on New Year's Eve in many parts of Great Britain, but especially in the south and west, was that of wassailing the fruit trees. A bowl of cider and a cake from the ritual meal of Christmas Eve or New Year's Eve was taken to the orchard; the cake was placed on a branch of the tree and the cider poured over the trunk. This ensured the fertility of the tree in the coming year. In Sussex a doggerel set of verses—the relic of a charm—was sometimes said as the cider was poured out, while the line, "Give earth and she'll not fail," which occurs in the Hampshire song, clearly shows the intention of the rite.

An interesting example of a blending of pagan and Christian is seen in the Cornish belief that on Christmas Eve the 'little people' (fairies) gathered at the bottom of a mine and celebrated a midnight mass.

December 25.

On Christmas Day a branch of the flowering thorn at Glastonbury was brought to London for presentation to the king and queen. This thorn was the staff of Joseph of Arimathea, who, on arriving at Glastonbury, thrust it into the ground on Dec. 25, when straightway it budded, bloomed, and withered. Henceforth on every Christmas Day it burst into bloom.

Owing to the change in the calendar, some confusion arose in the popular mind as to the date on which the festival of Christmas should be celebrated. This is still seen in the observation of Old Christmas Day on Jan. 6. In Yorkshire, to solve the difficulty, it was customary to listen at the hives of bees, as they began to buzz at the very hour on which Christ was born.

December 31.

NEW YEAR'S EVE.—A number of customs practised on Christmas Eve also appear on New Year's Eve. Such is the custom of 'wassailing,' when children or sometimes young girls go from house to house carrying a wassail bowl decked with ribbons and evergreens, which they offer to the inmates, as they sing a wassail song. Sometimes the wassail bowl was celebrated in the household, when the head of the family prepared a bowl of spiced ale from which he drank the health of the family and then passed it to each member, who did likewise. In Derbyshire this was combined with a form of divination. A cold posset was brewed of milk, ale, currants, eggs, and spice, in which was placed the wedding ring of the hostess. Each one present ladled up the posset. The one fortunate enough to 'catch' the ring would marry within the year.

HOGMANAY.—In Scotland it was customary on the last day of the year, known as Hogmanay, for children to go from door to door to receive gifts. In remoter parts a sheet was worn, doubled up in front to serve as a pocket in which the doles of oaten bread were placed. On coming to each door the children cried 'Hogmanay,' and sometimes a hogmanay song was sung.

The derivation and meaning of the word hogmanay is uncertain. It is recorded that it was an ancient custom in Franconia for the youth of both sexes to go about for two or three days before Christmas singing carols and wishing a happy New Year, for which they received gifts of pears, apples, nuts, and money. It has therefore been suggested that the name of the similar practice in Scotland and the north of England has been derived from a French greeting to the mistletoe, *Au guy l'an neuf*, itself to be traced to the Druids. In France on New Year's Eve bands of young people of both sexes roamed the country in fantastic dress, collecting money for "the lady in the straw," under a leader known as Rollet Follet. As they disturbed the vigils they were forbidden to visit the churches in 1598, and were finally suppressed owing to their disorderly conduct in 1668. Their cry, *Au gui menez tiré liré maint du blanc et point du bis*, has been suggested as the origin of the Scottish "Hogmanay trololay, gi' us o' your white bread and none o' your grey." More learned derivations from the Greek and Hebrew are even less convincing.

Apart from the derivation of its name, the meaning of the custom is clear. It is one of the communal processional customs in which the gift ensures prosperity to the donor, similar to the wassail and the St. Stephen's day procession of the wren. In the Highlands the Hogmanay custom included a sacrificial victim. A man was dressed in the hide of a bull, and was attended by young men, each armed with a staff on which was a piece of raw hide. They ran three times round each house in the direction of the sun, the young men beating the hide of the bull, and at the same time striking the walls of the house. This ensured the incidence of good luck. When they entered the house they uttered a blessing on it, and then singeing the piece of raw hide attached to their staves in the fire, they held it under the nose of each individual and each animal in the house, this ensuring freedom from misfortune, disease, and witchcraft.

In addition to the hogmanay, *guisarts*—boys with blackened faces and in fantastic dress—performed plays, similar to the English mumming plays, including a combat and the death and resuscitation of a principal character. This custom was suppressed by the influence of the Scottish church.

In the north of Ireland, children ensured good luck by going round and throwing twisted wisps of straw in at each door, a custom which may be connected with St. Brigid.

FIRE CUSTOMS.—At Biggar, in Lanarkshire, the old year was 'burnt out.' The day was spent in collecting brushwood and other combustible materials, which were lighted at the 'cross' at nine o'clock at night. Fires were also lighted on the adjacent hills. Everyone present threw some additional material on the flames when the fire had been lighted. The fire was made big enough to last until New Year's morning, so that anyone whose domestic fire had gone out could relight it from the embers, as no one would give a light for a fire on New Year's Day for fear of bad luck.

An even more interesting custom was that of the 'clavie' at Burghead, on the Moray Firth, when a fire of tar and wood was made in a barrel fitted on to a stone pole. It was first lit on the shore, and then, when burning freely, was carried around the bounds of the town. At one time all the fishing-boats were visited. The 'clavie' was then carried to an artificial eminence on a promontory and placed in a hollow in the centre of a pile of stones. After a few minutes the 'clavie' was cut down and the burning embers scattered among the crowd, who snatched them up and carried them home as a protection against witchcraft. With this last act may be compared the custom of preserving a part of the Yule log as a good-luck charm.

In the Isle of Man it was customary for the housewife to rake the ashes of the fire smoothly over the floor of the kitchen before retiring. If in the morning the ashes showed the footstep of a fairy pointing towards the door, it portended a death, but if the heel was in that direction, it betokened an addition to the family.

Societies and Academies.

DUBLIN.

Royal Dublin Society, Nov. 20.—**L. B. Smyth**: On the structure of *Palæacis*. Study of the coral *Palæacis axinoides* sp. nov. (previously recorded as *P. obtusa* Meek and Worthen) from the lower carboniferous rocks of Hook Head, Co. Wexford, revealed the presence of several features not hitherto observed. The young coral attached itself to a shell fragment, or other foreign body. A tissue of unique structure covers the outside of the colony. This tissue, as it increased in thickness by addition to its outer surface, gradually extended over the supporting object, finally enveloping it completely. A complex canal system is present.—**H. M. Fitzpatrick**: Coniferæ: keys to the genera and species, with economic notes. A detailed study has been made of the foliage characters of Conifers, and an identification key based on the external features and arrangement of the leaves, buds, and branchlets constructed.—**J. Reilly** and **D. McSweeney**: William Higgins: A pioneer of the atomic theory. An account was given of the life of the Irish chemist, William Higgins, F.R.S. (1766-1825), with particular reference to his work on atomic chemistry. Throughout a book published in 1789 he uses an atomic notation and anticipates many of the principles and details of Dalton's theory. He was the first chemist to recognise the law of multiple proportions and recognised in some cases the volume law of Gay-Lussac.

LEEDS.

Philosophical and Literary Society, Dec. 4.—**S. Brodetsky**: Equiangular and equilateral polygons in space. Given that an equilateral polygon in space is also equiangular, and given the angle between successive edges, to discover the possible forms for polygons of five and six edges respectively, and whether these forms are rigid or are capable of continuous variations. The problem is considered from the point of view of spherical trigonometry. The results agree with those obtained by Wightman constructionally.—**J. R. Wilby**: Gravitational fields in orthogonal co-ordinates. The problem is to find the natural geometry of a region of space-time, containing a distribution of matter, in the special case in which the space-time is a quadratic form of orthogonal type, and the potentials are functions of two of the independent variables. The problem is considered both for the originals and for the modified forms of the equations of the gravitational field.—**J. Ewles**: On the relation between luminosity and concentration in luminescent solid solutions. The Bruninghaus formula $I = ACe^{-nC}$ is a special case of the formula

$$I = \frac{AC}{(1+C)^{n_1}} + \frac{BC}{(1+C)^{n_2}} + \text{etc.},$$

deduced from simple assumptions in accord with modern views of the luminescent centre. Here C is the atomic concentration of the active atom in the transparent lattice, and n_1, n_2, etc., the number of positive atoms in a luminescent centre. The formula has been tested experimentally with the solid solution phosphor CaO(Bi), and found to be in excellent agreement with the results.—**E. C. Stoner**: Cosmic rays and a cyclic universe. The only source of energy compatible with the observed radiation and Jeans's estimated ages of stars is the annihilation of matter. The interpretation of Millikan's cosmic ray results depends on the absorption formula used. With that of Klein and Nishina the smallest absorption coefficient corresponds closely with the annihilation wave-length. Even if it is assumed that there is an upbuilding of atoms, and the purely speculative possibility of crystallisation of radiation into electrons and protons is admitted, a complete cycle for the universe would involve other improbable processes.—**Mrs. K. Lonsdale**: The symmetry of naphthalene. Carbon atoms having two A and two B valencies can be built up into a naphthalene molecule which has a centre of symmetry only, in agreement with X-ray investigations on naphthalene. The molecule so found also accounts satisfactorily for the differences in the absorption spectra of the ten dichlornaphthalenes.—**J. Grainger**: An infectious chlorosis of the dock. Fernow, in America, has described a 'virus disease' on *Rumex obtusifolius*. Experiments have been made on docks with the chlorosis found in England.—**A. Eccles**: The formation of methyl sodiochloromalonate and its reaction with iodine, with remarks on the stability of halogenoethanes. Methyl sodiochloromalonate reacts with iodine solution to yield methyl ethylenetetracarboxylate, no methyl-1 : 2-dichloroethanetetracarboxylate being formed. The instability of compounds of the latter type, and of poly-halogeno-ethanes in general, is explained by an application of the supposition (due to Ingold and Ingold) that the reactivity of the halogen atoms is determined primarily by the relative displaceability of the shared electrons in the carbon-halogen bond.—**Miss R. M. Tupper-Carey**: The development of the hypocotyl of *Helianthus Annuus* considered in connexion with its geotropic curvatures. To account for the two opposite geotropic reactions of the hypocotyl of this plant, a correlation is suggested between the first positive geotropic curvature, induced by mutation, with a stage of active division in the vacuolating cells behind the apical meristem; and between the negative geotropic reaction, which follows slightly later in the same organ, with a region where cell extension only is in progress.

PARIS.

Academy of Sciences, Nov. 26.—**E. Bataillon** and **Tchou-Su**: The anastral mitoses of activation.—Auguste Lumière was elected a *Correspondant* for the Section of Medicine and Surgery.—**G. Cerf**: The elimination of the constants and the singular solutions of a class of Monge's equations.—**H. Roussilhe**: The complete solution of the problem of the map in space.—**R. Audubert** and **Mlle. M. Quintin**: The study of imperfect contacts in continuous currents. The contact silicon-carbon, as well as detectors of the silver sulphide and lead sulphide type, present characteristics composed of two parabolic branches. By its stability and reversibility, it has been proved to be especially simple for the study of the phenomenon of rectification.—**Pierre Lacroute**: The spark spectrum of sulphur, S II, in the Schumann region.—**Paul Soleillet**: The polarisation of the light emitted during fluorescence.—**R. Dubrisay** and **Astier**: Kaolin suspensions. Experiments on the relations between the velocity of sedimentation of kaolin suspensions and the pH of the liquid.—**A. Smits**: The allotropic modifications of phosphorus. Remarks on a recent communication by Nicolaïeff on the same subject. The author does not admit that the curves given by Nicolaïeff prove a fourth allotropic modification of phosphorus.—**A. Travers** and **Malaprade**: Attempts at the isolation of new fluoborates. Boric acid and potassium hydrogen fluoride react in cold, concentrated aqueous solutions, giving crystals which on analysis prove to have the ratio B/K = 1 and F/K = 3.—**Georges Brus** and **G. Peyresblauques**: The ozonide of nopinene. The ozonide $C_{10}H_{16}O_3$ was isolated as a colourless viscous oil, and this, on prolonged boiling with 5 per cent potash solution, gave hydrogen peroxide,

formaldehyde, and nopinone, $C_9H_{14}O$. The yield of nopinone is good, more than 50 per cent.—**Raymond Ciry**: The structure of the southern edge of the primary massif of the Asturias.—**P. Fallot** and **R. Bataller**: Geological observations on the region of Velez-Rubio (Prov. of Almeria).—**Léon Moret**: The post-Hercynian stratigraphy of the southern slope of the High-Atlas in Glaoua (Morocco).—**J. Thoulet**: Deep submarine volcanoes and the double oceanic circulation. There exists in the ocean a double circulation between the upper and lower zones, one of solar origin and the other of internal volcanic origin, and the chemical and physical homogeneity of the sea water is caused by this double circulation.—**R. Combes**: The influence of traumatisms on the migration of substances in plants. In a recent communication the Sachs' method has been proved to be untrustworthy, due to the removal of portions of the leaf, and the effects of this traumatism on the exchanges of material between the organs.—**P. Gavaudan**: The presence of a parasitic fungus in the antheridia of *Marchantia polymorpha* and its action upon gametogenesis.—**Aug. Chevalier**: The origin of the Brazilian campos and the rôle of Imperata in the substitution of prairies for tropical forests.—**R. Leriche** and **R. Fontaine**: The existence in Vieussens ring of fibres sensitive to pressure effects. The importance of this for the surgical treatment of angina pectoris.—**Jean Saidman** and **Roger Cohen**: The properties of rays of wave-length 4–8 A. Clinical experiments show a marked difference between the action of rays of 6–8 A. and filtered rays of about 4 A. The effects of the latter resemble those produced by ordinary X-rays.—**L. Mercier**: The polymorphism of the male (pœcilandry) in *Cynomyia mortuorum*. Its signification.—**P. Bunau-Varilla**: Verdunisation in the contest against yellow fever. The application of the same prophylactic measures in the Gulf of Mexico and in western Africa have given different results: in the former there is an almost complete disappearance of the infection, whilst in the latter recurrence is frequent. The author gives reasons for supposing that the superiority of the American results is due to the chlorine treatment of the drinking water.—**Mme. Phisalix**: Vaccination against viper poison and experimental rabies by virus-venom mixtures with the virus in excess.

PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (2nd class, Natural Sciences and Medicine), Nov. 23.—**Zd. Frankenberger**: A study on spermatogenesis of reptiles (Part 2).—**E. Votoček** and **F. Valentin**: Rhamnoconvolvulic acid. Separated from 'resina jalapæ e radice ponderosa' by the action of baryta, the new well-defined, crystalline glycosidic acid, $C_{52}H_{92}O_{32}$ yields on hydrolysis, with 10 per cent sulphuric acid, 1 mol of a di-hydroxypalmitic acid, 4 mols of *d*-glucose and 2 mols of *l*-rhamnose.—**R. Lukeš**: Some derivatives of lævulic acid. A new method of preparation of fatty acids.—**R. Lukeš** and **V. Prelog**: Aryl-substituted amines of lævulic acid. The synthesis of some hydropyrrolic derivatives from *p*-dibromobenzene treated with Grignard's reagent. A contribution to the refracto-chemistry of lactones.—**V. Posejpal**: Resonance spectra and the Raman effect. The 'resonance' spectra of iodine and sodium vapour verify the author's assumption that in fluorescence and phosphorescence an effect analogous to Raman's is exhibited by an infra-red absorption band of iodine at 45·86–55·90 μ and one of sodium at 64·9–75·0 μ.—**K. Zavadský**: The statocysts of Amphipoda.—**Fr. Němejc**: Some interesting discoveries of fossil plants from carboniferous basins of middle Bohemia.—**K. Cejp**: Contributions to the anatomy and morphology of respiratory organs of some Marchantiaceæ.—**J. Mirovský**: Results of statistical methods on the variability of two species of *Closterium*.

ROME.

Royal National Academy of the Lincei, June 17.—**G. Armellini**: Variations in the diameter of the sun from 1901 to 1911, according to observations at the Royal Campidoglio Observatory. The horizontal radius of the sun has shown a regular increase from a minimum of 960·70″ in 1897 to a maximum of 961·88″ in 1908, after which it diminished, regularly except for the year 1910, to 961·67″ in 1911.—**L. Lombardi**: Measurement of the local dissipations of energy in a circumscribed part of the magnetic circuit.—**A. Angeli** and **R. Poggi**: The mobility of certain halogen atoms. The fact that aromatic compounds of the form $CH_3O \cdot C_6H_4 \cdot CH_2Cl$ and the analogous aliphatic compounds $CH_3O \cdot CH_2Cl$ readily lose the halogen as hydrogen chloride when treated with water or alcohol, is attributed to the linking of the halogen to the alkoxyl residue to give an oxonium derivative. The spontaneous loss of methyl chloride by chlorotrianisylmethane, with production of an amorphous substance, finds a parallel in the behaviour of the compound $CH_3O \cdot C_6H_4 \cdot CH_2Cl$, which similarly yields a complex substance having the characters of synthetic resins. The formula of hydrated formaldehyde, $OH \cdot CH_2 \cdot OH$, which exhibits a marked tendency to polymerisation, is analogous to that of salicyl alcohol, which readily forms resinous compounds.—**N. Parravano** and **G. Malquori**: Thermal decomposition of Bayer alumina. The thermal decomposition of Bayer alumina, Al_2O_3, $3H_2O$, results in the formation of lower hydrates, possibly Al_2O_3, $2H_2O$ and certainly Al_2O_3, H_2O, before the anhydrous oxide is reached.—**P. Vinassa**: Symmetrical electronyls and polyatomic molecules. Application of the considerations previously advanced in regard to monatomic molecules to the case of nitrogen, the halogens, and oxygen, which cannot have monatomic molecules, indicates that allotropy is confined to substances with other than monatomic molecules. Allotropy must, indeed, be regarded as due to varying peripheral electronic grouping in the polyatomic molecule.—**Vladimiro Bernstein**: Additions to the note on interpolation by means of holomorphic functions in a semiplane.—**E. Gugino**: The profile of rotating bodies the deformation of which is not disturbed when the bodies are cut into sections by planes normal to the axis.—**H. Geppert**: Progressive waves of permanent type in circular vessels.—**N. Mouskhelichvili**: The fundamental problem of two-dimensional hydrodynamics.—**L. Masciotti**: Investigation of the thread of the micrometer screw of the Ertel meridian of the Royal Campidoglio Observatory.—**A. Rostagni**: Application to geophysical investigations of T. Levi-Cività's theory relating to the influence of a conducting screen on the electromagnetic field of an alternating current parallel to the screen.—**F. Rasetti**: Wave mechanics of an alkaline atom in the electric field (2). The theory, previously developed, of the perturbation due to an external electric field on an atom of an alkali metal, is applied to the case of lithium. Lack of experimental data prevents checking of the results attained, but the known order of magnitude of the dielectric constants of vapours of alkali metals coincides with that deduced.—**A. Carrelli**: Width of certain lines of the mercury spectrum. The breadths of eleven mercury lines, especially of the anomalous *mP* series, are considered in relation to the internal and azimuthal quantic numbers.—**P. Misciatelli**: Separation of thorium from uranium by means of ether. If anhydrous ether and anhydrous salts (dried at 120°) are used,

complete separation of uranium nitrate from thorium nitrate may be effected, provided that the procedure is such that the ethereal solution becomes saturated with the uranium salt at that temperature. The increase in solubility of the thorium as the temperature falls may be due to the formation of complex compounds.—G. Natta and M. Strada: Spinels of tervalent cobalt: cobaltous cobaltite and zinc cobaltite. Zinc cobaltite, $ZnCo_2O_4$, may be prepared by calcining a mixture of zinc and cobalt nitrates. Comparison of the X-ray photograms of this compound and of cobaltous cobaltite, Co_3O_4, shows that the two are isomorphous, both crystallising in the cubic systems with a lattice of the spinel type. The unit cells have identical dimensions, the side being 8·06 ± 0·005 A., and the respective calculated densities are 6·11 and 6·27.— **P. Agostini**: Heats of formation of double chlorides of copper and potassium. The mean value obtained for the heat of solution of $CuCl_2$. 2KCl is − 1·63 Cal. and the heat of formation from the constituent chlorides, + 4·09 Cal. For $CuCl_2$. KCl, the corresponding values are + 2·181 Cal. and + 4·59 Cal.—**F. De Carli**: Heats of formation and hydration of cobalt potassium carbonate and copper sodium carbonate. The following results have been obtained: $K_2CO_3 + CoCO_3 = K_2CO_3, CoCO_3 + 5·76$ Cal.; $K_2CO_3, CoCO_3 + 4H_2O = K_2CO_3, CoCO_3, 4H_2O + 11·37$ Cal.; $Na_2CO_3 + CuCO_3 = Na_2CO_3, CuCO_3 + 10·33$ Cal.; $Na_2CO_3, CuCO_3 + 3H_2O = Na_2CO_3, CuCO_3, 3H_3O$ + 9·296 Cal.— **S. Berlingozzi**: Derivatives of *d l*-asparagine.— **A. Ferrari** and **A. Baroni**: Importance of crystalline form in the formation of solid solutions. (2) Thermal analysis of the anhydrous system $LiCl - CdCl_2$. Thermal analysis of this system reveals the existence of the compound $3CdCl_2, 4LiCl$, melting at 522° and confirms that of $3 CdCl_2, 2LiCl$, melting at 516°. Complete miscibility in the solid state exists between these compounds and the pure chlorides.— **N. A. Barbieri**: Physiological culture. **A. Quilico** and **E. Fleischner**: Sulphonic derivatives of unsaturated compounds. The use of aminosulphonic acid as a sulphonating agent has been applied to the preparation of sulphonic derivatives of styrene, anethole, isosafrole, and isoapiole.— **L. Scremin**: Variations in the ionic equilibrium as factors in pharmacological action. Widely varying proportions of calcium chloride are necessary to inhibit the action of different convulsant drugs, pyramidone being highly sensitive to this salt.— **O. M. Olivo** and **E. Slavich**: Frequency of mitosis in the embryonal heart of the chicken in various stages of development and in cultures *in vitro* of the same material.

SYDNEY.

Linnean Society of New South Wales, Sept. 26.— **W. D. Francis**: Features of the vegetative anatomy of the Australian white beech (*Gmelina Leichhardtii*). The anatomy of the tree is outlined. Hesperidin or a hesperidin-like substance, which was found in the branchlets and leaves, may be a secondary product of photosynthesis and it may be used in the construction of wood. Gmelinol may be a partial decomposition product of the wood.— **A. Théry**: A new buprestid from Australia. Description of a new species of *Mastogenius* from Victoria. The genus, now first recorded from Australia, is known from Chile, Brazil, United States, Grenada, and Transvaal.— **G. H. Hardy**: Third contribution towards a new classification of Australian Asilidæ. An account of the prothorax in the Dasypogoninæ. Two new tribes are proposed, one left unnamed pending further information, but under it the genus *Cryptopogon* White is redefined, a second species, *C. obscurus*, being incorporated as new. Laphriini, a tribe previously formed and regarded as complex, is now divided, a new tribe following a group previously proposed by Hermann.— **A. B. Walkom**: Fossil plants from the Esk District, Q. Twenty-two species are dealt with, of which eight are described as new, and three others are recorded for the first time from the Esk Series. The new species confirm previous determinations of the age of the series as Upper Triassic (possibly Rhætic).

VIENNA.

Academy of Sciences, Oct. 18.— **W. J. Müller** and **K. Konopicki**: The theory of passivity phenomena. (3) The current-density time curve in the case of covering passivity.— **R. Weiss** and **W. Knapp**: The action of *o*-phthalyl-chloride on *p*-cresol-methyl-ether and *p*-thio-cresol-methyl-ether.— **A. Müller** and **P. Bleier**: Reduction of cyclo-hexa-nonisoxim (*a*-keto-hexa-methylene-imin).— **A. Kailan** and **E. Leisek**: The decomposition of persulphates in aqueous solution. Coefficients were found for the decomposition of sodium persulphate in the presence and in the absence of sodium hydrogen sulphate, of sulphate, of nitrate, of hydroxide, of phosphates. Potassium persulphate decomposes more slowly than sodium persulphate.— **R. Weiss** and **S. Kratz**: The action of *o*-tolyl-magnesium-bromide on the dilacton of benzo-phenon-*o*-dicarboxylic acid.— **C. A. Bobies**: Geological studies in the Tertiary of Triesting- and Piesting-bay.— **O. Koller**: The geographical distribution of fresh-water fishes in southern Europe.— **H. Priesner**: Australian Thysanoptera.— **W. Frenzel**: Nutrition and colour formation in *Chlorosplenium aeruginosum*. This fungus, which causes the green rot of wood, may be grown in pure culture, starting from the ascospores, from infected wood, or from fragments of the fruit body. Growth is slow; it attacks pith and rays, it penetrates vessels, it is aerobic, and has a wide range on the acid side of neutrality. Colour formation increases up to about 26° C. The colouring matter is dissolved by phenol and slowly precipitated by alcohol; it is easily reduced to red or yellow products, easily reoxidised to green; it is an indicator for alkalies.— **M. Gleispach**: The influence of vapours and gases on the fall of leaves and removal of other organs.— **A. Paltauf**: The staining of living cell nuclei. Erythrosin, eosin, and dahlia-violet gave clear positive results. The nuclear staining was favoured by addition of nitrates, also by alcohol and by ether. Cells with coloured nuclei can still be plasmolysed or deplasmolysed. Rise of temperature promotes staining.— **G. Koller** and **H. Ruppersberg**: An unusual mode of preparing 2-amino-pyridine. By heating 2-chloro-pyridine with pure pyridine.— **F. Wessely** and **J. Mayer**: Carbonyl-bisamino acids and their transformation products. Stereometric considerations are involved.— **R. Dworzak** and **A. Enenkel**: The bromination of valeraldehyde.— **R. Dworzak** and **W. Prodinger**: Studies on bromo- and oxy-aldehydes. (3) Preparation of crystallised lactic acid aldehyde and its behaviour towards dilute aqueous alkalies.— **H. Mache**: Rutherford's alternating field method for determining the velocity of gaseous ions.— **A. Skrabal** and **M. Rückert**: The velocity of saponification of mono- and di-chlor-acetic-acid ester.— **F. Hölzl**: The alkylisation of octo-cyano-tungstic acid.— **O. Dischendorfer** and **O. Polak**: Researches in the field of phyto-chemistry. (5) Allobetulin.— **S. Meyer**: Communication of the Radium Institute (No. 226). Comment on the relations between the atomic weights of uranium, radium, radium-G, and helium.

Oct. 25.— **T. Schmid**: The coincidence problem in the descriptive geometry of four-dimensioned space.

Official Publications Received.

BRITISH.

Journal of the Chemical Society: containing Papers communicated to the Society. November. Pp. iv+2827-3098+x. (London: Gurney and Jackson.)

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1927. Pp. vi+123. (London: H.M. Stationery Office.) 4s. net.

The Indian Lac Association for Research. Bulletin No. 1: Physical Properties of Shellac Solutions, Part 1. By M. Rangaswami and M. Venugopalan. Pp. 14. (Nankum.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 39, Part 3. Pp. 223-368+plates 18-28. (London: Edward Stanford, Ltd.) 5s.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 37: Paper-Pulp and Cellulose from the Eucalypts by the Sulphite Process. By L. R. Benjamin and J. L. Somerville. Pp. 84. Pamphlet No. 9: A Forest Products Laboratory for Australia; Justification for its Creation, Outline of its Organisation and Rough Estimate of Cost. By A. J. Gibson. Pp. 28. (Melbourne: H. J. Green.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 15, No. 3, November. Pp. 735-879. (Plymouth.) 5s. net.

FOREIGN.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 44: On the Interference of Wind Tunnel Walls of Rectangular Cross-Section on the Aerodynamical Characteristics of a Wing. By Kwan-ichi Terazawa. Pp. 69-81. (Tokyo: Kosekai Publishing House.) 0.17 yen.

University of California Publications in Zoology. Vol. 30, No. 13: The Molts of the Loggerhead Shrike, *Lanius ludovicianus* Linnaeus. By Alden H. Miller. Pp. 393-417. 30 cents. Vol. 32, No. 1: A Distributional Summation of the Ornithology of Lower California. By Joseph Grinnell. Pp. 300. 3.75 dollars. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.)

Bergens Museum. Årsberetning, 1927-1928. Pp. 112. Bergens Museums Årbok 1928. Naturvidenskapelig rekke. Hefte 2. Pp. 52+49. (Bergen: A/S John Greigs Boktrykkeri.)

Diary of Societies.

SATURDAY, DECEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (II.): Signalling in Air and Water.

MONDAY, DECEMBER 31.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Madame Gabrielle M. Vassal: A Journey through French Indo-China (Christmas Lectures to Young People) (I.).

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (in Botanical Theatre, University College), at 5.30.—Dr. P. B. Ballard: The Psychological Basis of the Break at Eleven Years of Age.

TUESDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (III.): Notes and Noises.

TELEVISION SOCIETY (at Engineers Club, Coventry Street), at 8.—J. C. Rennie: Scanning Methods used in Television.

WEDNESDAY, JANUARY 2.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Capt. P. P. Eckersley, T. L. Eckersley, and H. L. Kirke: The Design of Transmitting Aerials for Broadcasting Stations.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—G. Wilkinson: Economic Application of Electricity to Low Temperature Heating Purposes.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, JANUARY 3.

ROYAL SOCIETY OF ARTS, at 3.—Capt. Sir Arthur Clarke: Ships and Lighthouses (Dr. Mann Juvenile Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (IV.): How Sounds are Analysed.

LINNEAN SOCIETY OF LONDON, at 5.—C. E. Moss: A New Genus of the Hydrocharitaceæ from the Zambesi.—G. S. Carter and L. C. Beadle: (a) The Fauna of the Swamps of the Paraguayan Chaco in Relation to its Environment. I. Physico-chemical Conditions of the Environment; (b) Notes on the Habits and Development of *Lepidosiren Paradoxa*.—W. A. Cunnington: The Argulidæ of the Expedition to Brazil and Paraguay.—R. Gurney: The Branchiopoda of the Expedition to Brazil and Paraguay.—E. Meyrick: The Microlepidoptera of the Expedition to Brazil and Paraguay.—J. Stephenson: The Oligochæta of the Expedition to Brazil and Paraguay.—H. W. Parker: The Amphibia and Reptilia of the Expedition to Brazil and Paraguay.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Society) (in Chemical Department, Bristol University), at 7.30.—Prof. W. E. Garner: Some Properties of Flame and Combustion.

FRIDAY, JANUARY 4.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—Dr. H. R. Mill: Capt. Cook and the Great Southern Continent (Christmas Lectures to Young People) (II.).

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—W. H. Lawes and others: Discussion on Precautions in the Use of Standard Instruments.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Major A. W. Farrer: The Engineer Salesman Abroad.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.—Discussion on the Prints in the Holcroft Collection.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—K. W. Willans: The Geared Steam Locomotive.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. K. W. Earle: Previous Land Connexions in the Lesser Antilles (Lecture).

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Thomas' Café, Swansea).—A. Grounds: Preparation of Coal for the Market.

SATURDAY, JANUARY 5.

ROYAL INSTITUTION OF GREAT BRITAIN (at Institution of Electrical Engineers), at 3.—A. Wood: Sound Waves and their Uses (V.): The Ear and What it Does.

PUBLIC LECTURES.

FRIDAY, JANUARY 4.

IMPERIAL COLLEGE OF SCIENCE, at 5.30.—Dr. R. Campbell: Mountains and their Origin (Swiney Lectures). (Succeeding Lectures on Jan. 7, 9, 11, 14, 16, 18, 21, 23, 25, 28, and 30.)

SATURDAY, JANUARY 5.

NEW EDUCATION FELLOWSHIP (English Section) (in Library, Central Hall, Westminster), at 5.30.—Sir Michael Sadler: Examinations.

CONGRESSES.

DECEMBER 31 TO JANUARY 5.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Monday, Dec. 31, at 3.—Earl of Lytton: Some Aspects of the Problem of Education in India (Presidential Address).

At 5.30.—British Psychological Society (Education Section).—Dr. P. B. Ballard: The Psychological Aspect of the New School Organisation.

Tuesday, Jan. 1, at 2.30.—Society for Experiment and Research in Education.—J. H. Whitehouse and others: Ruskin and Education.

At 3.—School Nature Study Union.—Dr. C. Tierney: Nature's Architecture.

Wednesday, Jan. 2, at 2.30.—Royal Drawing Society.—Rev. S. A. McDowall and others: The Value of Drawing to the Study of Science.

At 5.—Prof. H. J. Fleure, Miss M. D. Brock, E. R. Thomas, A. Saywell, and others: Joint Conference on The Influence of Examinations on Education.

Friday, Jan. 4, at 11 A.M.—British Broadcasting Corporation.—Demonstration of Educational Broadcasting.

At 2.30.—Medical Officers of Schools Association.—Dr. A. A. Mumford: Physical Activity and Physical Training in Relation to Scholastic and University Progress.

JANUARY 2 TO 5.

SCIENCE MASTERS' ASSOCIATION (at Cambridge).—Prof. A. C. Seward: Presidential Address.—Prof. A. S. Eddington: The Interior of a Star.—Prof. T. M. Lowry: The Arrest and Promotion of Chemical Change.—J. T. Saunders: Raising Animals in Cultures and their Use.—Prof. E. V. Appleton: Large Scale Optical Experiments.—Sir William Pope: Colour Photography.—Prof. J. Barcroft: Hæmoglobin.

JANUARY 3 TO 5.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Thursday, Jan. 3, at 11.30 A.M.—Prof. J. Sölch: Geomorphological Problems of the Eastern Alps.

At 5.—Dr. P. W. Bryan: Natural Environment related to Human Activity in the Corn Belt of N. America.

At 6.15.—W. Clayton and others: Discussion on Rural School Work: Geography in the Rural School.—Miss E. N. Broom and others: Discussion on Preparatory School Work: Outdoor Geography.—Miss E. G. R. Taylor and others: Discussion on Senior and Central School Work: Sketch Maps: the Shorthand of Geography.

Friday, Jan. 4, at 10 A.M.—E. J. Orford and others: Discussion on Educational Re-organisation and the Teaching of Geography.

At 11.45 A.M.—Sir H. G. Lyons: The Geographer and his Material (Presidential Address).

At 2.30.—Prof. C. B. Fawcett: The Balance of Urban and Rural Populations.

Saturday, Jan. 5, at 10.30 A.M.—Dr. Vaughan Cornish: On Linguistic Frontiers in Central Europe dating from Heathen Times.

At 11.45 A.M.—Hon. Secretary: Summary of the Results of Discussions held on the previous days.

JANUARY 3, 4, AND 5.

NORTH OF ENGLAND EDUCATION CONFERENCE (at Heaton Secondary Schools, Newcastle-upon-Tyne).

Thursday, Jan. 3, at 11.15 A.M.—The Marquess of Londonderry: Presidential Address.

At 2.45.—Miss E. R. Conway and others: School Books.

Friday, Jan. 4, at 10 A.M.—A. R. Pickles and others: Free Place Examinations.

At 11.15 A.M.—Miss L. Jowitt and others: Social Activities in Education.

At 2.45.—A. Watson and others: Education in Relation to Industry and Commerce.

Saturday, Jan. 5, at 10 A.M.—F. A. Hoare and others: The League of Nations and the Schools.

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The various Supplements should be collated and bound with the numbers with which they were issued.